



OXFORD MEDICAL PUBLICATIONS

EMERGENCIES  
OF GENERAL PRACTICE





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## PREFACE

### TO THE SECOND EDITION

A LARGE amount of new material has been introduced in this edition ; many of the chapters have been practically re-written or re-arranged, and the whole work has been carefully revised. The authors have been fortunate in securing the co-operation of their colleague Dr. Percy Smith, who has written the chapter on the Emergencies of Insanity, which they think will be found of great value.

A few new illustrations have been added, and several of the old figures and diagrams have been improved.

## PREFACE

### TO THE FIRST EDITION

THIS book has been written in the hope that it may prove a useful supplement to the systematic works on Surgery and Medicine, by gathering together in a concise form for easy reference certain acute and urgent conditions which require prompt recognition and treatment.

In making our selection it is inevitable that we should have included certain conditions which some critics would not regard as emergencies, and have omitted others which in their opinion should have been included.

Diagnosis has been discussed in as practical a manner as possible. In cases of emergency it is often impossible to make use of the more refined diagnostic methods which are available in routine work ; indeed, in many instances, exactitude of diagnosis must be postponed until after the relief of urgent symptoms.

In some cases, however, it is the diagnosis that constitutes the emergency, as in the recognition of the infectious fevers ; in such cases, therefore, we have gone into the diagnosis in considerable detail.

In dealing with treatment we have endeavoured to enter fairly fully into the methods of immediate treatment and only briefly to indicate the after-treatment. Alternative methods have not been fully discussed, or even, in many cases, mentioned. In an emergency the practitioner requires, not a discussion of the relative value of alternative methods, but a guide as to some one method which, if not always the best, has at least the merit of having been found by experience to be sufficiently good.

The book is almost entirely a record of personal experience,

and this, if apology is needed, must be our excuse for the somewhat dogmatic tone which we have adopted.

In the chapters on the Ear and Anesthetics, we have had the valuable assistance of our colleagues Mr. H. J. Marriage and Dr. Z. Mennell. The chapter on the Eye has been written by Mr. J. F. Cunningham, to whom also our best thanks are due.

For the photographs we are indebted to the kindness and skill of Dr. F. E. Shipway, whilst Mr. D. C. Bluett has taken the utmost care and trouble in the preparation of the drawings.

Blocks illustrating many of the instruments have been kindly lent by Messrs. Allen & Hanburys.

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# EMERGENCIES OF GENERAL PRACTICE

## CHAPTER I

### SHOCK

SHOCK and collapse are terms very frequently used in an interchangeable sense to describe the train of symptoms which results from some severe injury, a prolonged operation, or loss of much blood. Although in both the main feature is a fall of blood-pressure, yet the reasons for that fall continuing, perhaps even to a fatal termination, have been shown by G. W. Crile to be fundamentally different. In collapse, the vaso-motor centre is *inhibited* by some sudden severe afferent stimulus, or by loss of blood, but is capable of responding to stimulation by drugs and other means; in shock, the vaso-motor centre is *exhausted* by prolonged or repeated afferent impulses, and consequently requires time for recovery, during which the blood-pressure must be maintained by other means. Shock is consequently by far the more serious condition. Whilst, however, there is clearly an underlying and extremely important difference between these two states, it is unfortunately not always possible to distinguish them clinically. The clinical symptoms are identical. Crile<sup>1</sup> has demonstrated in the nervous system certain definite and constant changes taking place in the cells in consequence of injury, fear, hæmorrhage and toxæmia. These changes vary from alterations in the staining reactions of the cell protoplasm in slight cases, up to complete disintegration of the cells in fatal cases. These changes must be taken as the anatomical basis of the condition known as shock, and it is clear that their degree will determine the prospect of recovery in any given case.

It is essential that the practitioner should have a clear conception of the organic changes present in shock as contrasted with the transient 'functional' derangement of the central nervous system in collapse, or in syncope as exemplified by an ordinary fainting attack induced by a sudden mental impression.

<sup>1</sup> *Brit. Med. Journal*, October 1, 1910

The primary and fundamental factor in shock is a serious *fall in blood-pressure*. All the other symptoms associated with shock are either due to the same cause acting upon parts of the brain other than the vaso-motor centre, or are the consequence of the fall in blood-pressure.

*Clinical symptoms of shock.* The pulse is easily compressible, of small volume, rapid, and sometimes irregular. The pressure may be estimated roughly by the feeling of the pulse, but is more accurately determined by some form of sphygmomanometer such as that of Riva Rocci. In old people the rigidity of the arteries may give a false impression of the blood-pressure, and must be allowed for, lest the patient be assumed to be in better condition than he really is. Other important symptoms are rapid, shallow, and often irregular respiration, depressed mentation, general muscular weakness, lowered temperature, diminution or suppression of urine, sweating and an expression of a more or less characteristic kind, in which the face is pallid and pinched, and the eyes sunken.

#### PREVENTION OF SHOCK

The precautions to be taken against shock, as well as the measures to be adopted in its treatment, depend upon a clear conception of its causation, as well as its pathological anatomy.

Cribe has shown that the above-mentioned cell changes are caused by (a) severe and repeated afferent impulses whether sensory in the ordinary meaning or not, e.g. from manipulation of intestine, or section of a large nerve trunk whilst the patient is under an anæsthetic; (b) psychical influences, particularly fear; (c) loss of blood; (d) toxæmia, either from bacterial toxins or drugs (ether and chloroform).

In emergency work one or more of the above-mentioned factors are likely to be already present when the practitioner first sees the patient; the psychical influence and loss of blood in a severe injury, e.g. a cut throat; the alarm, pain, irritation of the peritoneum, and toxic absorption in a healthy patient suddenly seized with perforative appendicitis. In these cases not only has the shock already present to be treated, but all available measures must be taken to prevent additional shock during the operation.

The psychical element can be minimized by allaying the patient's fears, by preventing him from seeing or hearing the preparations for operation, and also by the hypodermic injection of morphia and scopolamine (hyoscine hydrobromide) gr.  $\frac{2}{100}$  -  $\frac{1}{100}$ . Loss of

blood must be guarded against on ordinary surgical lines. The effect of afferent impulses can be minimized by gentleness of manipulation, and in the case of amputations by injecting novocaine into the large nerve trunks before dividing them. In suitable cases spinal anaesthesia may be used, in conjunction with a minimal dose of chloroform, as a means of preventing shock in major operations upon the lower part of the body.

### *Choice of an Anaesthetic*

Both the choice of an anaesthetic and the method of its administration are of the utmost importance in every operation, but more especially in procedures of urgency where other shock-producing factors are already present

A. *General anaesthesia.* Crile has shown that even the prolonged administration of nitrous oxide and oxygen is unattended by the structural changes in the nerve cells distinctive of shock, thus differing from the effects of ether and chloroform. With the proper apparatus available, and an anaesthetist familiar with its use, this method of general anaesthesia is most useful, but in most cases of emergency outside of hospital practice, the choice of a general anaesthetic is of necessity between ether and chloroform, or a mixture of the two.

Ether tends to maintain the blood-pressure so long as it is being administered, but, like all stimulants, it fails to produce this effect in conditions of profound shock, and may even conduce to the further exhaustion of the central vaso-motor mechanism. Chloroform, on the other hand, causes a steady fall in blood-pressure, in addition to possessing its own special dangers, cardiac and respiratory, when given in excess. In emergency work, then, ether is the anaesthetic of choice, but there are many conditions in which, upon other grounds than those of safety, its use is contra-indicated. Thus it is, unless simply given upon an open mask, unsuitable in the very young and the aged; it should not be used for those suffering from injuries and disease of the chest; it is inconvenient in many abdominal operations where complete relaxation of the abdominal wall is required, and in cerebral operations it may increase the difficulties by causing venous engorgement. When chloroform is given alone, the use of the Vernon-Harcourt apparatus, by allowing a minimal quantity to be administered, reduces the danger considerably. In many cases a convenient and safe anaesthetic is to be found in a mixture of three parts of ether and two of chloroform, given either upon an

open mask or through a special inhaler, such as Hewitt's. Whether ether, chloroform, or a mixture of the two has been chosen, the anaesthetist must do all in his power to minimize the shock of the operation by attention to the following *preventive measures*.

The most important consideration, seeing that the anaesthetic promotes shock, is to give the minimum amount of the anaesthetic compatible with the abolition of actual consciousness, but, as Dudley Buxton has insisted, unless the higher perceptive centres are in abeyance, the operative shock may be greatly increased. It is still more the duty of the anaesthetist to see that the operative shock is not added to by an overdose of the anaesthetic. It should be borne in mind that the greater the traumatic factor, often so marked in cases of urgency, the less is the margin of safety with the dosage of the anaesthetic.

The next most important fact to remember is that up to a certain point the arterial tension rises with venous congestion. If from any interference with respiration there is even a slight cyanosis, the blood-pressure will rise from stimulation of the vaso-motor centre by the venous blood. This stimulation further exhausts an already weakened centre, whilst the rise of blood pressure may give a false sense of security. Moreover, such a rise of pressure is additionally dangerous, as it increases the amount of hemorrhage, both venous and arterial, at the site of operation. Whenever, therefore, any cyanosis occurs, the anaesthetist must, either by attention to posture, pulling forward the tongue, clearing the throat, and, in addition to these measures, by the administration of oxygen, make certain that he is not deceived as to the state of the vaso-motor centre by a temporary rise of blood pressure due to venous stasis. Hence it follows that the administration of oxygen is one of the most valuable means of preventing shock. The maintenance of the body temperature both during and after the operation is another very valuable measure.

**B. Local anaesthesia.** Some operations of urgency are best done under local anaesthesia, as, for example, a strangulated hernia in a patient who, on account of age, shock, or some cardiac, pulmonary, or other disease, is an unsuitable subject for a general anaesthetic. Some abdominal operations, such as the relief of intestinal obstruction, may, under similar circumstances, be performed under local anaesthesia. It is of special value in operating for empyema when the patient is very ill and the respiration greatly embarrassed.

(a) *The application of cold.* This method is almost restricted to the incision of subcutaneous abscesses. A fine spray of ether or

ethyl chloride is directed upon the site of the proposed incision until the skin is literally frozen, when the cut can be made without any pain being felt. The objections to this method are the hardness of the tissue which has to be cut through, and the pain which is experienced as the cold passes off.

(b) *Local application of analgesic drugs.* The uncertainty and risks attending the use of cocaine render its employment undesirable, particularly in the quantities in which it would be required for an operation of any magnitude. There are, however, other drugs, which, while possessing sufficient analgesic properties, are almost if not quite free from toxicity even in comparatively large doses. They can, moreover, unlike cocaine, be sterilized by boiling. These drugs are eucaine, stovaine, novocaine, and tropacocaine. It is found that if adrenalin is used together with the analgesic drug, the effect is increased both in intensity and duration. A large number of different formulæ have been recommended by various writers, and many preparations can be obtained commercially in sealed phials, sterilized, and ready for use. One of the best is Professor Braun's solution, consisting of novocaine, 0.5 per cent, suprarenin borate, 0.00064 per cent, and sodium chloride, 0.9 per cent.

For an operation of any magnitude a dose of morphia of about  $\frac{1}{4}$  grain should be given before the operation is begun. The patient should be prevented from seeing what is going on, and his attention may be distracted by conversation during the operation.

These drugs may be employed in different ways, namely, by (1) general infiltration of the field of operation, and (2) deliberate 'blocking' of the main sensory nerves by injection into or around them, not necessarily at the site of the operation but also at a distance; for example, blocking of the ulnar nerve at the wrist for an amputation of the little finger.

The anaesthesia appears much more rapidly if the injection is made into the nerve trunk than when perineural infiltration is employed. C. M. Page is of opinion that stronger solutions of the drug do not act much more rapidly than dilute, though their effect is more persistent; that in fact the bulk of the solution is of more importance than its concentration. The application of a Martin's bandage above the site of operation, in the case of the limbs, has the effect of prolonging the anaesthesia by retarding the diffusion and absorption of the drug.

(1) *General infiltration.* A large hypodermic syringe provided



with a specially long sharp needle should be used, though the ordinary pattern can quite well be made to serve in an emergency. The needle is thrust into the skin so as to lie in the deeper layers of the true skin, and not in the subcutaneous tissue, along the line of the proposed incision, and the injection made during its withdrawal. This insures, if properly carried out, absence of pain during the division of the skin. As the deeper parts are reached they can be rendered insensitive by repeated applications of the solution, or by injection into the nerves. The actual time of the operation is thus unavoidably lengthened, but this is a matter of little moment compared with the advantages which, in selected cases, the avoidance of a general anæsthetic confers.

(2) *Intra- and peri-neural injection.* These methods involve a more accurate knowledge of topographical anatomy than the foregoing, and in emergency work would apply chiefly to amputations. The principle has been applied to the operation of rib resection for empyema by C. M. Page,<sup>1</sup> whose method is best described in his own words :

'Before the operation area is washed, a puncture is made on the vertebral side of the proposed incision, if possible to the outer side of the erector spinae. The needle is passed in at the level of the intercostal space above the rib to be resected, the point is first made to impinge on the surface of the upper rib of the space and is then made to pass downwards till it dips into the subcostal groove ; 3-5 c.c. of the selected solution are here injected. Two further punctures are made in relation to the two ribs below this, and the same procedure repeated, i.e. including the rib to be resected. This effects a perineural infiltration of the intercostal nerves. Just before commencing the operation the skin itself in the line of the incision is infiltrated. If about ten minutes have elapsed from the time of the first punctures, complete anaesthesia of all the structures involved in subsequent manipulation will be present, the entire insensitiveness of the periosteum, bone, and pleura, being in marked contrast to the pain present in those cases where simple infiltration alone has been employed.'

(3) *Spinal anaesthesia.* We are not concerned in this chapter with the merits or demerits of spinal anaesthesia as a rival of general anaesthesia in routine work. But as a means of preventing shock in grave emergency operations this method undoubtedly has a place. When anaesthesia is satisfactorily induced, the afferent impulses from the operative field are effectually prevented from reaching the sensorium ; with general narcosis this effect is

<sup>1</sup> *St. Thomas's Hospital Gazette*, December 1900.

not produced unless the depth of anæsthesia is far deeper than is necessary to abolish consciousness.

Against this very great advantage must be set the fact that the psychical factor of shock is not abolished as it is with general narcosis, and this objection is increasingly greater in proportion to the patient's racial or individual sensitiveness. Crile has advocated the combined use of spinal and general anæsthesia in certain cases. The former prevents shock-producing afferent impulses from reaching the central nervous system, whilst the latter, given in the small quantity necessary to abolish actual consciousness, does away with the shock-producing psychical factor. The hypodermic injection of morphia and scopolamine in addition to the spinal anæsthetic has a similar effect. Our own experience of spinal anæsthesia has not been encouraging, but from a small number of cases we are not entitled to speak dogmatically. Our conclusions are drawn in the main from two sources—a paper by C. M. Page dealing with a large number of reported cases as well as his own experience, and papers by H. Tyrrell Gray based upon his large personal experience of the method in children.

Page, in December 1909, tabulated over 23,000 cases collected from various sources as follows :—

• Drug.	No. of Cases.	Fatal.		Collapse.	Oculo-motor Palsies.	Rate of Mortality.	
		A	B			A	Total.
Cocaine . . .	6,875	12	13	54	—	1 in 573	1 in 271
Tropacocaine . .	7,459	6	5	12	3	1 in 1243	1 in 678
Stovaine . . .	6,234	7	1	16	24	1 in 890	1 in 670
Eucaine . . .	817	1	—	—	—	1 in 817	1 in 817
Novocaine . . .	1,355	3	—	10	7	1 in 449	1 in 449
Alypin . . .	414	3	1	5	—	1 in 138	1 in 103
Totals . . .	23,154	32	20	97	34	1 in 722	1 in 444

A. Deaths attributed to the direct action of the drug.

B. Death, occurring when some other condition, sufficient of itself to produce death, was present.

Of these drugs stovaine, novocaine, and tropacocaine are most frequently employed. The last named appears to be at once the safest and the least efficient. Stovaine has the great disadvantage of being precipitated and rendered inert by certain chemicals, particularly alkaline fluids. If, then, the instruments are boiled, as is usually done, in water with added soda, the drug is precipi-

tated. It is necessary to use plain water for sterilizing the syringe and everything that is used for the spinal operation.

Many different formulæ are employed. H. P. Dean recommends: Stovaine, 0.1 gram.; sodium chloride, 0.1 gram.; and distilled water, 1 gram. A. R. Barker uses 10 per cent stovaine with glucose 5 per cent, and distilled water 85 per cent.

The following solution can be obtained commercially, ready for use, in sealed phials, each containing 3 cubic centimetres:

Novocaine	. . . . .	0.15 gram. (5 per cent)
Suprarenin	. . . . .	0.000625 gram.

The dose of this fluid should be from 2 to 3 cubic centimetres, or from 35 to 50 minims.

H. Tyrrell Gray<sup>1</sup> reported 300 personal cases in children, with one death and six failures to produce anaesthesia. He has shown conclusively that the method can be employed satisfactorily in children, the psychical element in the production of shock being almost or entirely absent. Many of the operations in this series were performed for conditions of extreme gravity, and it appears certain that the abolition of shock and the absence of the toxic effects of a general anaesthetic contributed in great measure to the brilliant results obtained in some of these cases, notably the recovery of a child only seven months of age after resection of an intussusception and anastomosis by H. A. T. Fairbank. In this connexion one point of special interest is brought out by Gray, namely, that 'so long as the anaesthesia is complete, surgical shock is altogether absent, but that, when the effect of the stovaine on the nerve roots begins to wear off, and *anaesthesia* passes into *analgesia*, signs of shock begin to appear.' It must not be supposed that spinal anaesthesia is devoid of danger, though doubtless with increasing familiarity with its technique and improvements in the preparation of the drugs employed, these dangers will be obviated or minimized. Death has occurred from respiratory failure and bulbar paralysis from the drug reaching too high a level, and from meningitis. Serious and alarming after-effects have been recorded many times, such as persistent vomiting, severe headache, rigors, collapse, respiratory difficulty, and paralysis of the bladder followed by cystitis.

*Technique.* An ordinary antitoxin syringe, provided with a specially long, sharp needle, may be used for the injection. If the patient is well enough, the sitting posture is the most con-

<sup>1</sup> *Lancet*, June 11th, 1910.

venient (Fig. 1); if not, he should be lying upon one side with the back flexed as much as possible (Fig. 2). The needle may be entered in the mid-line just above the spine of the fourth lumbar vertebra, which lies on a level with the highest points of the iliac crests, and thrust forwards and a little upwards; or it may be entered half an inch to one side of the mid line, and thrust



FIG. 1. Sitting posture for lumbar puncture.

forwards, inwards, and upwards, so as to pass between the laminae of the third and fourth lumbar vertebrae (Fig. 2). As soon as the needle has entered the spinal theca, cerebro-spinal fluid will flow from it. It is essential that a flow of cerebro-spinal fluid should occur before the injection is made, in order to be quite certain that the point of the needle is in the subdural space. The syringe should now be connected with the needle, some of the cerebro-spinal fluid allowed to mix with the solution in it, and the injection performed. The patient should immediately

be placed in the recumbent position, with the shoulders somewhat raised so as to prevent the drug reaching a dangerously high level. As the drug takes effect, there is first a feeling of numbness in the legs, followed by weakness, and ultimately, after a few minutes, there will be complete analgesia and a varying degree of motor paralysis.

#### TREATMENT OF SHOCK

This consists essentially in adopting all the means available for raising the lowered blood-pressure. Naturally one first



FIG. 2. Lateral recumbent posture for lumbar puncture.

thinks of the rapidly diffusible stimulants, ether, alcohol, and strychnine, but too often their action is only analogous to whipping the tired horse; there may be a momentary response, only to be followed by a further fall, and this is especially the case with alcohol and ether. The essential point is that the vaso-motor mechanism should be stimulated peripherally and not centrally; the blood-pressure must be raised and kept raised until the central vaso-motor mechanism has had time to recover. The means to this end are as follows:—

1. **Drugs.** *Adrenalin* raises the blood-pressure by its action upon the peripheral arterioles. It may be given by hypodermic injection (5 minims of the 1 in 1,000 solution of adrenalin chloride).

or, better, by intravenous injection of saline solution containing 10 minims of the 1 in 1,000 solution in 2 pints of fluid. In this form it is best given by the continuous or intermittent subcutaneous method (see p. 15), because by this means it is possible to continue the peripheral effect of the drug over longer periods, and in accordance with the requirements of the case as indicated by the blood-pressure. The effect of adrenalin is very transitory, its properties being rapidly lost in the tissues. It is, for this purpose, quite useless to give it by the mouth. *Hemisin* is a commercial product containing the active principle of the medulla of the suprarenal gland. Its action is that of adrenalin, and it may be given by the mouth (5 to 15 minims of the 1 in 1,000 solution), or hypodermically (1 in 100,000).

*Tyramine* is an active principle derived from ergot, and may be given either hypodermically or by the mouth for the purpose of raising the blood-pressure in shock, its action in this respect being similar to that of adrenalin. It has the advantage that its effect lasts much longer than that of adrenalin.

Preparations made from the *posterior lobe of the pituitary gland* have an effect similar to that of adrenalin, and the effect lasts longer. These, when available, are used in preference to adrenalin when required for subcutaneous injection, and the effect is stated to be better when intramuscular injection is employed. One preparation is on the market as 'vaporole pituitary extract', and is supplied in sealed glass phials each containing 1 c.c. representing 3 grains of fresh posterior lobe of the pituitary body. The dose is from  $\frac{1}{2}$  to 1 c.c. Another preparation which can be obtained in sealed phials ready for use is known as *Pituitrin*. Each phial contains 15 minims of fluid, equivalent to 3 grains of fresh posterior lobe of pituitary body, the amount suitable for a hypodermic or intramuscular injection. A third similar preparation is sold under the name *Pituitrin*, of which 1 c.c. (17 minims) represents 1.5 grains of the fresh posterior lobe.

These products are made by well-known firms of manufacturing chemists.

2. SALINE INFUSION. By running normal saline solution directly into the venous system, or by its more gradual absorption from the rectum or subcutaneous tissues, the blood-pressure can be raised, but the effect is very transitory, and the fluid is rapidly removed by the skin and kidneys. When given slowly and in combination with adrenalin the effect can be prolonged considerably.

The fluid to be used is sterilized normal saline solution, which

can readily be made by dissolving a drachm of common salt in each pint of water. When, in case of emergency, common salt has to be used, the solution should be filtered through a piece of sterilized gauze or muslin, in order to free it from hairs and other foreign matter. For rectal injection the fluid need not, of course, be sterilized, but for the other methods sterilization must be carried out with the greatest care, and throughout the operation the most scrupulous asepsis must be maintained.

(i) *Intravenous infusion.* This is by far the most rapid and efficient way of introducing fluid into the circulation, and the one most generally applicable. The apparatus required consists of a scalpel, artery forceps, scissors, aneurysm needle, cannula, rubber tubing and funnel, thermometer, measure glass, ligatures and sutures.

*Operation* (Fig. 3). The skin over the front of the elbow having been thoroughly cleansed, the largest vein visible (usually the median basilic) is exposed by an incision an inch in length. It may be necessary to tie a bandage round the upper arm in order to render the veins sufficiently visible; it need hardly be said that the bandage must be removed as soon as the cannula is in place. By means of the aneurysm needle two silk ligatures are then passed beneath the exposed vein, about an inch apart; the lower one is tied and the upper one left loose. The funnel, tube, and cannula, all previously sterilized with scrupulous care, are then completely filled with the saline solution at 105° F. (to which a little brandy, if thought necessary, may be added) so as to exclude all bubbles of air. A small oblique incision is made into the vein, and the cannula introduced in an upward direction (Fig. 4). The upper of the two ligatures, which had been left loose, is tied with a single hitch, so as to hold the cannula in place. The fluid is now allowed to flow into the vein, the funnel being elevated as high as may be necessary to cause it to flow with moderate rapidity. This height is subject to great variation, a free flow being sometimes obtained with an elevation of a couple of feet, whilst at other times the funnel must be raised three or four feet. When sufficient fluid has been introduced, the cannula is withdrawn, the ligature tied tightly and the wound closed.

When the case is very urgent, the operation may be shortened by introducing a large antitoxin needle directly into a vein, stabbing through the skin and vein wall in the direction of the heart, and attaching the tube and funnel to the needle.

In cases of severe hemorrhage it is often advisable to add to



FIG. 3. Intravenous saline infusion.

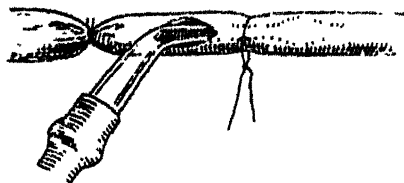


FIG. 4. Infusion cannula in place.



the normal saline solution a small quantity of adrenalin chloride, 10 minims of the 1 in 1,000 solution in 2 pints of saline. If more than 2 pints of fluid is necessary, the additional quantity should contain no adrenalin. The amount to be introduced is to be estimated by the effect upon the pulse. When saline alone is used, however much is infused, the blood-pressure is only very temporarily raised above the normal. After an infusion sweating is sometimes most profuse, and the amount of urine passed may be enormous. An undoubted danger attending the introduction of an excessive quantity of fluid directly into the circulation is oedema of the lungs, from which death occasionally occurs.

(ii) *Rectal infusion.* Fluid can be absorbed into the circulation with moderate rapidity from the rectum, and this is the most convenient method when the case is not a very urgent one. The fluid may be given by the rectum either by the *intermittent* or by the *continuous* method.

(a) *Intermittent rectal infusion.* The patient's pelvis being somewhat elevated, the fluid is allowed to run slowly into the rectum by means of a tube and funnel, the latter being raised not more than a couple of feet above the patient. If the fluid is allowed to run in quickly, it will cause reflex contraction of the bowel and will be expelled. In an adult from fifteen to twenty ounces can be introduced every hour or two. This method is of no value in severe cases, when the circulation is so enfeebled from profound shock or severe loss of blood that absorption cannot take place.

(b) *Continuous rectal infusion.* This method, devised by J. B. Murphy, is of great value when it is desired to supply a patient with a large quantity of fluid and when the rapidity of its administration is not of great moment. It is therefore not often suitable for cases of severe hemorrhage or profound shock. It is largely employed in the after-treatment of peritonitis (see p. 259), and is also of great value in cases of serious loss of body fluid from severe and prolonged vomiting.

The apparatus may be of the most simple character, as shown in Fig. 5. A receptacle kept constantly replenished with saline solution, which is maintained at a constant temperature of about 105° F., is placed conveniently near the patient at a height of about 12 or 18 inches above the level of the bed. A flexible metal tube (Fig. 6) with numerous perforations at one end is arranged comfortably round the patient's thigh, introduced into the rectum and connected with the outflow tube of the saline flask. A clip

upon the rubber connecting tube controls the rate of flow. By this means two pints an hour or even more can be introduced into and absorbed from the rectum.

(iii) *Subcutaneous infusion.* Saline solution can be absorbed with fair rapidity from the subcutaneous tissues, and this is a method particularly adaptable for children. It is best given by the continuous method, as follows: one or more large hypodermic needles are connected by means of a long piece of

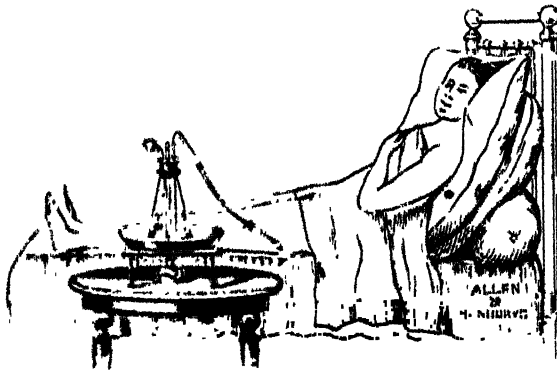


FIG. 5. Continuous rectal infusion.

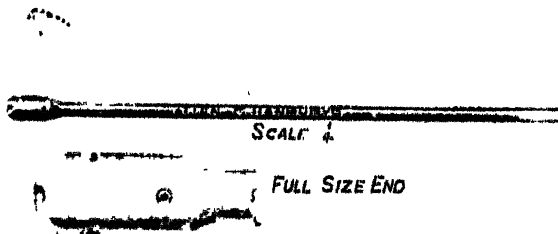


FIG. 6. Flexible metal tube for rectal infusion.

rubber tubing with a vessel containing the saline solution (Fig. 7). Everything must be sterilized and the whole procedure conducted with the most scrupulous regard for asepsis. The needles are thrust into the subcutaneous tissue of the flank or chest wall and the vessel is suspended above the bed at such a height as to ensure the fluid being forced slowly into the subcutaneous tissue. It may be necessary to alter the position of the needle if a very tense swelling is produced. The temperature of the fluid must be kept constantly at 105° F. In this manner a pint or more can be introduced in the space of an hour, but it is a tedious and sometimes painful method and requires the undivided attention of a nurse.

(iv) *Intraperitoneal infusion.* In abdominal operations saline solution may be left in the peritoneal cavity, from which it is rapidly absorbed into the circulation, but the amount which can be introduced in this manner is not large and the method is obviously capable of but limited application.

3. OXYGEN. The continuous inhalation of oxygen is undoubtedly of use in the treatment of shock, and when available, should always be employed.

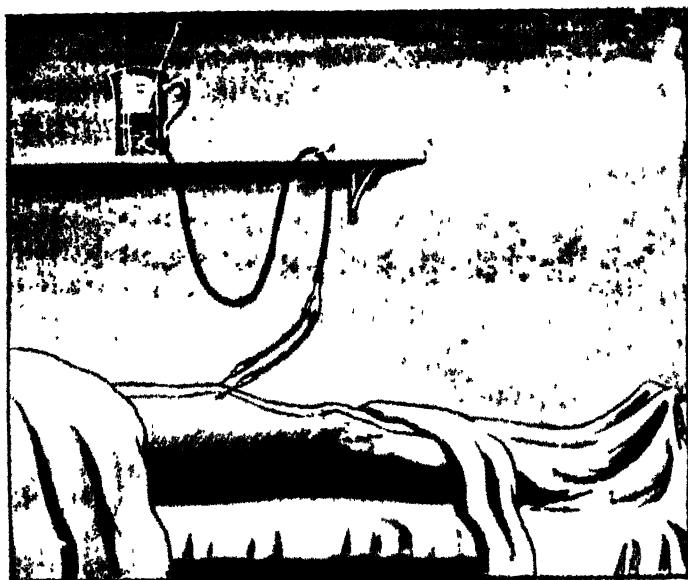


FIG. 7. Subcutaneous infusion.

4. HEAT. Warmth applied over the whole body by means of hot blankets and hot-water bottles is a most valuable aid to the other measures employed in the treatment of shock. The temperature of the operating theatre or room must not be below 70° F., and special care taken during the removal of the patient from one to the other.

5. MECHANICAL MEASURES. The support of the venous system by means of bandaging is capable of raising the blood-pressure. The limbs should be firmly bandaged from below upwards with flannel bandages, and, when circumstances permit, a firm abdominal binder should be applied. The posture also is important. The patient's head should be kept low by raising the foot of the bed and removing the pillows.

6. The mental element of shock can be reduced by giving encouragement to the patient, calming his fears, and keeping him as far as possible free from all excitement. To this end also the use of morphia is most valuable, and should be given unless contraindicated by some condition such as peritonitis. The morphia is advantageously combined with scopolamine (hyoscyne hydrobromide) thus, morphine, gr.  $\frac{1}{4}$ , scopolamine, gr.  $\frac{1}{100}$ .

## CHAPTER II

### EMERGENCIES OF ANÆSTHESIA

It should be clearly understood that most of the difficulties and dangers which arise during the administration of a general anæsthetic, even in emergency work, are preventable, and that the well-known remark that the patient 'takes the anæsthetic badly' too often means that the anæsthetic is badly given. Due attention to the selection of the drug, correct posture of the patient, and careful watching of the respiration and blood-pressure throughout, are essential. The consideration of such difficulties naturally falls under two headings, namely *prevention* and *treatment*.

#### A. PREVENTION

(i) *Preparation of patient.* In emergency work this can usually be only of the simplest kind. Nevertheless much may be done by considerate behaviour to allay a patient's fears, and to keep him from the sight and sound of the preparations for operation. For the same reason it is often an advantage to give a dose of morphia a quarter or half an hour before the operation, unless there is some definite contra-indication such as diffuse peritonitis.

(ii) *Posture.* The best position for the administration of an anæsthetic is the dorsal, and fortunately in the majority of cases it is also the most convenient for the surgeon. The head should be on the same level as the body, and turned to one side, a small pillow or sand-bag being placed beneath the shoulder away from which the head is turned. This renders respiration easier, and enables mucus to drain freely from the mouth. In this position the anæsthetist can keep the jaw forward comfortably. It is when the exigencies of the case demand some posture other than the dorsal one that difficulties are more liable to arise, and in many cases the posture which has to be assumed is such as to limit the choice of the anæsthetic to chloroform. Some of the positions which may have to be adopted, and which may give rise to difficulties, are as follows :—

(a) In the *lithotomy* position sudden elevation of the thighs in the obese causes pressure upon the diaphragm, with consequent

dyspnœa and cyanosis. To overcome this the shoulders may be lowered, but if this manoeuvre is insufficient, the position of the thighs will have to be modified. When giving ether in this position, some time will elapse before the legs are sufficiently lax to allow the extreme degree of flexion required, clonus often appearing on any attempt being made to get the limbs into position. For this and other reasons many surgeons prefer chloroform. In giving this drug care must be exercised at the moment the sphincter is stretched, as this procedure is often followed by a long inspiratory effort, during which vapour containing a dangerously high percentage of chloroform may be inhaled.

• (b) In the *lateral* position no difficulty should arise, and it is only when cushions are used to push up the loin in kidney operations that it is difficult to obtain a good position for the head; a small sand-bag under the upper arm is then useful. In operations for empyema, it must be remembered that the sound side of the chest is downwards, so that an already embarrassed respiration may be rendered still more difficult.

(c) Operations which necessitate the *prone* position are usually severe and prolonged. In this posture it is essential that the respiratory movements are not unduly interfered with. The head should be kept well over the end of the table, or supported upon a proper head-rest.

(d) The *sitting* posture is rarely called for, except in dental cases, and should be rigidly avoided. Chloroform must never be given in this position, and if a longer anæsthesia is necessary than that which can be obtained with gas and oxygen, ether should be given. The laryngeal reflex must be retained in order to ensure that nothing passes into the larynx. Ethyl chloride abolishes this reflex early, so that the greatest care must be taken when employing this drug.

(e) The '*adenoid*' position, which ought to be adopted in opening a retropharyngeal abscess, is often the cause of trouble. The patient should lie in the dorsal position, and the anæsthesia produced with chloroform should be followed up with the chloroform-ether mixture (C. 2, E. 3) until the lid reflex just disappears. The anæsthetic should then be stopped, the gag introduced, and the head lowered over the end of the table, the neck being at the same time well supported. The reflex will reappear with the lowering of the head, and a couple of minutes' quiet anæsthesia will follow. Should any cyanosis appear, the patient must at once be turned into the lateral position.

### B. TREATMENT

The dangers which may arise during anaesthesia are either *respiratory* or *circulatory*, the former being by far the more common.

(i) **RESPIRATORY.** The trouble may arise in one of two distinct ways, central or nervous, and peripheral or mechanical.

Respiratory failure of *central* origin results from overdose. The symptoms of overdose are, a large pupil inactive to light, absence of the corneal reflex, shallow respiration and a dusky pallor. It is here that the great difference between ether and chloroform is exemplified, for with ether there is a much larger margin of safety, as the circulation remains good even though the respiration may practically have ceased. Whenever the pupil is noticed to be large, it is a safe rule that the drug should be withheld altogether until the administrator is certain of the depth of anaesthesia present.

When, with the symptoms just described, the respiration gradually gets more feeble, and the pallor increases, immediate action must be taken. The operation must be stopped at once, and the patient placed in the dorsal position, with the head thrown back over the lowered head of the table; the mouth must be opened with a gag, and the tongue pulled forward with forceps, though not too forcibly; the finger should then be swept over the back of the throat, to make sure that no mechanical obstruction is present. All this should take but a very few seconds, and then, if natural respiratory efforts are not made, artificial respiration must at once be performed. Silvester's method is as follows: the anaesthetist grasps the patient's elbows, and draws the arms first outwards and then inwards, well above the head. He then reverses the movements, and, when the chest is again reached, makes pressure upon it. At this moment an assistant may help the expiratory phase by making pressure upon the lower ribs. These movements are to be carried out slowly and regularly, each complete cycle occupying about four or five seconds. They should be persisted in until some voluntary respiratory effort is made, or until the heart's action has completely ceased and further efforts at resuscitation are clearly useless.

The use of drugs, and of other measures, is of secondary importance compared with artificial respiration, and the anaesthetist should let nothing interfere with that. Time wasted in giving a hypodermic injection, to the neglect of artificial respiration, may mean the death of the patient. Whilst the movements are

being continued, an assistant may with advantage give a full dose of strychnine hypodermically, namely, in an adult, 10 minims of the one per cent solution. If the anæsthetic is chloroform, hypodermic injections of ether may also be given.

*Mechanical obstruction* to respiration under anæsthesia may result from—

(a) *Sucking in of the lips.* This usually occurs in cases in which artificial teeth have been removed prior to the commencement of the anæsthetic. Spasm of the lips also occurs in some cases. The remedy for this condition is the insertion of an ordinary dental prop at the side of the mouth, not at the centre as this prevents the tongue from coming forward. Where the teeth are deficient, and ether is being given from a Clover's inhaler, the face-piece may be used in such a manner as to press down the lower lip.

(b) *The tongue* is by far the commonest cause of obstruction of the airway. When difficulty arises from this cause, all that is necessary as a rule is to correct the position of the head and push forward the jaw. It is important to note that both sides of the jaw should be first pushed forward from the angles; when this has once been done, it is quite easy to keep the jaw forward from one side. If this simple procedure fails to give relief, the mouth must be opened with a gag and the tongue forceps used. The forceps must not be left on for any length of time, lest bruising be produced. If it is necessary to hold the tongue forward for any length of time, it is better to pass a stout silk thread through it, as this causes little or no subsequent discomfort to the patient.

(c) *Mucus* in the throat often causes obstruction, especially with ether anæsthesia. It not only produces mechanical obstruction, but may also produce spasm of the larynx. In these cases posture is all-important, and it is useful to have the corner of a towel inserted in the dependent angle of the mouth to act as a drain. If there is any cyanosis, the anæsthesia must be allowed to become lighter so that the patient may get rid of the mucus by coughing, but should this be inadvisable from the surgeon's point of view, the mouth must be opened with a gag and the mucus removed with a mounted sponge. The anæsthetist should not, under these conditions, be tempted to change from ether to chloroform until the throat has been cleared and a brisk corneal reflex is present.

Blood and pus may act in the same manner as mucus, and require the same treatment.



(d) *Foreign bodies* causing respiratory obstruction are dealt with in Chapter IX.

(e) *Laryngeal spasm* causes obstruction more frequently than is usually supposed, and especially during light anaesthesia. It can readily be recognized by the crowing character of the respiration. During operations such as circumcision in young children this spasm often leads to difficulty. Brisk rubbing of the lips is usually efficacious, together with a change of anaesthetic from chloroform to ether. When chloroform is being used in such a case, care must be taken lest an overdose be given during the long inspiration which occurs when the spasm passes off.

(f) *Vomiting* is a frequent and dangerous cause of respiratory obstruction, either from laryngeal spasm or from mechanical causes. Vomiting is always preceded by swallowing, and the anaesthetist should regard this as a warning. When vomiting does occur, attention must be paid to the position of the head and neck; the anaesthetic should be stopped, and the mouth opened with a gag, so that the pharynx may be swallowed clear. These difficulties should not arise when the patient has been properly prepared for an anaesthetic; but in emergency work vomiting may be a source both of difficulty and danger.

Vomiting is a special source of danger during operations for intestinal obstruction, because of the tendency for large quantities of intestinal fluid to be suddenly ejected from the stomach, whether the patient is deeply under or not. If he is so deeply under that the laryngeal reflex is absent, this fluid may flood the air passages in a moment, so that the patient is literally drowned ('fecal drowning'); the inhalation of a smaller quantity of this fluid will prove fatal with scarcely less certainty from subsequent septic broncho-pneumonia. Attention to these possibilities is therefore a matter of extreme importance. It must be realized that this form of vomiting is not so much the ordinary reflex act as a mechanical emptying of the stomach whenever it becomes sufficiently full of the regurgitated intestinal contents, and that it therefore occurs whether the anaesthesia is light or deep. To push the anaesthetic when this danger threatens is to court disaster from abolition of the laryngeal reflex. Very light anaesthesia is essential, and the escape of the regurgitated fluid must be assisted by attention to the patient's posture. The head must be slightly lowered and turned to one side, a small pillow being placed beneath the opposite shoulder, and the mouth must be kept well open.

Lavage of the stomach is useless, and only wastes time, for,

until the obstruction has been relieved, the stomach is constantly receiving additional quantities of fluid from the intestine. It is, however, a good plan to empty the stomach by means of an œsophageal tube first and then to give the anæsthetic, leaving the tube in place during the operation. As soon as the operation is finished, the stomach may be washed out with warm water and the tube finally removed.

In some cases the danger of 'faecal drowning' would undoubtedly warrant the employment of spinal anæsthesia (see p. 6).

(g) *Respiratory obstruction already present*, in such cases as epiglottitis and cellulitis of the neck, may be exaggerated by the attempt to administer an anæsthetic (p. 65).

(ii) *CIRCULATORY*. Emergencies due to failure of the circulation fall under two headings, namely, (a) sudden primary cardiac failure and (b) dangerous fall of blood-pressure due to shock or collapse.

(a) *Sudden primary cardiac failure* is the gravest accident that the anaesthetist has to face. It is due to a relative overdose, and is readily recognized by the sudden ghastly pallor, and cessation of the pulse.

The treatment must be immediate, for the loss of a few seconds may make all the difference between death and recovery. The operation must be stopped at once, the patient placed in the dorsal position, and artificial respiration performed. Hypodermic injections are useless when the circulation has failed. Direct stimulation of the heart affords the best chance of saving life, to which end a strong faradic current, if available, may be applied to the precordium. The writers are aware of one case in which puncture of the heart with a needle undoubtedly restarted cardiac action, after which the patient made an excellent recovery. Massage of the heart with the fingers thrust through an incision beneath the left costal margin has been attended with success in a few cases, and may be tried as a last resort in a desperate case. Inasmuch as the brain can only withstand the complete cessation of its circulation for a very limited time, cardiac massage should be undertaken not later than two or three minutes after the cardiac arrest. Complete recovery has attended this procedure in a few cases. In others the heart's action is restored, but the patient dies in from one to twenty-four hours without recovery of consciousness, the brain having been irretrievably damaged by the prolonged anæmia.

(b) *Shock and Collapse*. The second type of circulatory failure

is that in which the blood-pressure falls, either gradually or suddenly, to a dangerous level, and towards which exhaustion of the medullary centres from the shock of injury or operation, as well as the chloroform poisoning, contribute. In severe and prolonged operations, such as intestinal resection when muscular relaxation of the abdomen is necessary, the danger of death from circulatory failure is most to be feared. It is in these cases that the pulse, rather than the respiration, gives the first warning of danger.

The treatment is *preventive* and *resuscitative*, as dealt with fully in the preceding chapter (p. 10).

## CHAPTER III

### HEMORRHAGE

OF all the emergencies with which the practitioner may at any time be called upon to deal, there is none more pressing than hæmorrhage, and at the same time there is no emergency which, with few exceptions, is more amenable to prompt treatment, or from the effects of which, in the majority of cases, recovery is more rapid and complete. The escape of blood from a large artery may be so rapid as to cause death in a few seconds; a copious venous hæmorrhage may prove fatal very quickly and even capillary hæmorrhage, if long continued, may terminate fatally. Concealed or 'internal' hæmorrhage, such as may occur after an abdominal injury or an operation for hæmorrhoids, is particularly dangerous, because it may only be indicated by the general symptoms to which the loss of blood gives rise; it may not be diagnosed, in fact, until a very serious and even dangerous loss of blood has taken place.

The *general symptoms* which indicate a severe degree of hæmorrhage are readily recognizable, although they closely resemble those of shock alone. Indeed diminution of the flow of blood through the brain due to reflex vaso-dilatation in the splanchnic area is a most important factor in shock. These general symptoms are as follows. There is a feeling of faintness, together with restlessness, sighing, yawning, and disturbances of vision; the patient becomes cold, pale, and anxious and the pupils dilate. The most reliable sign of all is the pulse; its rate increases *patri passu* with the loss of blood, whilst its volume diminishes and it becomes soft and compressible. If the bleeding still continues, the patient becomes more and more blanched, until the mucous membranes are almost white; consciousness is lost; the pulse becomes more and more feeble and irregular, and death ensues.

The *treatment* of hæmorrhage must be carried out upon the same general lines whatever its cause or situation. Obviously, the first thing is to prevent any further loss of blood, whether the hæmorrhage is taking place externally or internally. The methods applicable to particular situations are discussed under their appropriate headings below. When this has been done,

and not until then, stimulants may be administered, warmth applied by means of hot bottles, and, above all, fluid supplied to take the place of that which has been lost. The head should be kept low, by removing the pillows and raising the foot of the bed, for which purpose, if special blocks are not available, a couple of ordinary kitchen chairs may be used. This position is not a comfortable one, and, in order to secure the necessary rest and quiet, morphia may be required.

The patient is usually very thirsty, a symptom which points to the obvious and natural means of supplying fluid to the circulation. It is therefore both cruel and unnecessary not to allow him to drink freely. Firm bandaging of the limbs from below upwards is a useful means of supplying blood to the more important parts of the body and should not be neglected.

The various methods of saline infusion are given in the chapter on Shock (p. 11).

## SPECIAL FORMS OF HÆMORRHAGE

### I. PRIMARY ARTERIAL HÆMORRHAGE

Arterial hæmorrhage is recognized by the bright red colour of the blood as it escapes (venous blood rapidly becomes red on exposure to the air), and by the fact that it escapes in a series of jets synchronous with the cardiac systole. There are, however, exceptions to these rules: for the blood may be very dark in a cyanosed patient, and, if proceeding from a deep wound, the intermittent character of the bleeding may be obscured.

Temporary arrest of arterial bleeding can, unless the bleeding-point is quite inaccessible, always be secured either by digital pressure upon the bleeding-point or the main artery, or by the application of a tourniquet. As soon as the necessary preparations can be made, the bleeding-point must be found and ligatured.

It sometimes happens that a wound has been made in the near neighbourhood of a large artery, and that, by the time the surgeon sees the case, hæmorrhage has ceased. The question then arises as to whether any active measure should be taken, or whether, on the contrary, the wound should be merely dressed in the usual manner and the case watched. The following rule may safely be taken as a guide: if (a) the history clearly indicates that the bleeding from a wound in the neighbourhood of a large artery was profuse and arterial in character, or (b) there is a large or an increasing subcutaneous hæmorrhage, and parti-

cularly if pulsation is felt in the swelling, or (c) the general symptoms, in the case of a wound of the abdomen or thorax, point to an increasing loss of blood, then operation must forthwith be undertaken.

The following are the chief reasons for taking this step :—

(a) The bleeding, held in abeyance by the lowered blood-pressure, may recur at any moment.

(b) Widespread subcutaneous hæmorrhage is apt to be followed by septic complications.

(c) The pressure of the effused blood may be severe enough to cause gangrene of a limb.

(d) A traumatic aneurysm may result.

(e) In the case of an intraperitoneal hæmorrhage, peritonitis, localized abscess, and other complications may follow (see p. 287).

The object of the operation is *to reach and ligature the bleeding vessel at the point of injury*. The reasons for choosing the bleeding-point itself, in preference to tying the main vessel on the cardiac side, are as follows :—

(a) It is not always certain what vessel is wounded. A stab in the upper part of the thigh, for instance, may have wounded either the superficial or the deep femoral artery. In the latter case ligation of the superficial femoral might be performed on the supposition that one of its branches was bleeding, and this would not only fail to arrest the hæmorrhage, but would also involve considerable risk of gangrene.

(b) Ligation of the wounded vessel at a distance, together with the obliteration of the same vessel at the point of injury, necessitates the subsequent dilatation of two sets of collateral vessels instead of one, and thereby increases the risk of gangrene.

(c) It is necessary to ligature the wounded artery on the distal as well as the proximal side of the wound, for otherwise recurrent hæmorrhage may take place as soon as the collateral circulation is established.

*Operation.* The wound and surrounding skin are to be thoroughly cleansed, as described in Chapter IV. The opening must next be enlarged, the clot removed with a blunt spoon under a stream of hot sterilized saline solution, and a search made for the wounded vessel. During these manipulations the main artery requires to be controlled by an assistant. If the bleeding has ceased it may be very difficult to find the wounded vessel, but usually the hæmorrhage will begin afresh from displacement of clot during the manipulations, in which event the operation becomes much easier. When the bleeding-point has been

discovered, the artery must be ligatured both above and below it, and divided between the two ligatures. The material to be used is not of great moment, provided that it is sterile, and not so fine as to cut through the coats of the artery. Fairly thick sterile silk is the best as well as the most generally accessible material, but catgut should be avoided, partly because its sterility is not always above suspicion, partly because the knots made in it are apt to slip, and partly because it may become absorbed too soon.

If after careful and patient search the bleeding-point cannot be found, a plug of sterile gauze should be packed tightly into the wound, beginning at its deepest point, and secured in place with a firm dressing and bandage.

It sometimes happens that at the bottom of a deep wound a bleeding-point can be secured with artery forceps, but cannot be tied, as, for instance, in a deep wound of the palm. In such a case the forceps should be left *in situ* for from twenty-four to forty-eight hours, the dressing being applied around and over the handles.

If an artery has been lacerated without external wound, as may happen in violent attempts to reduce a dislocated shoulder, treatment must be carried out on lines similar to those described above for a wounded artery.

## II. REACTIONARY ARTERIAL HÆMORRHAGE

This is merely a recurrence of the primary hæmorrhage, and, as its name indicates, is due to the rise of blood-pressure which accompanies recovery from loss of blood or from the shock of an operation. This increase of blood-pressure may cause the slipping of a badly tied ligature, or the displacement of a clot from a wounded but unligatured artery. Sometimes the escape of blood externally will call attention to the accident, as in the case of bleeding from the lingual artery after excision of the tongue. In other cases pain and increasing distension of the tissues in the neighbourhood of the wound will indicate the presence of hæmorrhage. But severe and even fatal post-operative hæmorrhage may show itself only by the general symptoms occasioned by the loss of blood. For instance, after an operation for hæmorrhoids, the blood, prevented from escaping externally by a tightly-contracted sphincter, may make its way into and distend the rectum to such an extent as to cause very alarming symptoms from the hæmorrhage. Still more grave is

intra-abdominal hæmorrhage, because a large quantity of blood may escape into the peritoneal cavity in a short time, as, for example, if the ligature slips from the stump of an ovarian pedicle, or from a piece of omentum or mesentery.

*Treatment.* Reactionary hæmorrhage is to be treated upon exactly the same lines as primary hæmorrhage, namely, by securing the bleeding-points first, and then, if the case is a severe one, by administering fluid to replace the blood lost.

In this connexion it is advisable to make special mention of certain examples of post-operative hæmorrhage which have now and then to be dealt with.

(i) *After excision of the tongue.* If a silk thread has been left attached to the stump of the tongue, as should always be done on account of its liability to fall backwards and impede respiration, the bleeding can be temporarily arrested by simply pulling upon the thread. If this fails, the stump should be hooked forward and compressed with the finger. As soon as a good light, instruments, and assistance are available, the bleeding-point must be sought for upon the face of the stump, and secured. Should this fail it may be necessary to tie the external carotid artery below the origin of the lingual. The classical procedure of ligation of the lingual artery in the neck is difficult and usually futile.

(ii) *After operations for hæmorrhoids.* As already stated, the hæmorrhage in such a case may be concealed, profuse, and even fatal. An anæsthetic must be given, the sphincter dilated, the blood and clot removed from the rectum with hot irrigation, and the bleeding-point secured. This may be done by catching it in forceps and tying it, or by passing a suture beneath it and tying firmly. Should these manœuvres fail the rectum must be plugged. A roll of gauze or a marine sponge with a long stout thread tied around it, should be passed into the rectum well above the operation area; this roll should be as large as can conveniently be passed into the bowel, and the attached threads should be long enough to protrude through the anus. When the threads are pulled upon the hæmorrhage is effectually controlled, and they should then be tied around a second roll of gauze pressed firmly against the anus.

(iii) *After excision of a varicocele.* This is an accident which occurs occasionally as the result of tying the ligature insecurely, or of dividing the veins too close to the ligature. When it is remembered that the spermatic artery is included in the part of the spermatic cord that has been cut across, it is not surprising that the slipping of the ligature from the proximal end should



be followed by extensive bleeding into the subcutaneous tissues. The lower part of the abdominal wall and the scrotum very rapidly become infiltrated with blood. When this accident happens, it is necessary to give an anæsthetic, reopen the wound, and tie the bleeding vessel, at the same time removing as much blood and clot as possible.

(iv) *After excision of the tonsil.* Bleeding which does not cease spontaneously, or which recurs some hours after the operation, can almost always be readily controlled by pressure. A small roll of gauze, wetted with adrenalin (1 in 1 000) or with turpentine, is applied to the cut surface, counter-pressure being made by a finger placed just below the angle of the jaw. Failure to arrest the hæmorrhage by this means may be followed by an attempt to seize the bleeding-point with artery forceps. Another method, recommended by A. T. Smith and Harold Barwell, consists in suturing together the pillars of the fauces over the cut surface of the tonsil. "The suture must be passed from behind forwards, and the principal difficulty is caused by the extremely small space between the posterior pillar and the pharyngeal wall: a small needle with a very sharp curve is therefore essential. The pillars must also be sewn together through their entire length, and it is wise to begin at the lower end while thoroughly depressing the tongue, for this is the part which is most likely to escape attention."

(v) *After intranasal operations.* The treatment is the same as for spontaneous epistaxis (p. 34).

(vi) *After operations upon the bladder and urethra.* See 'Hæmaturia', p. 329.

(vii) *Post-operative intra-abdominal hæmorrhage.* See Chapter XIII.

(viii) *After operations upon the stomach.* Hæmatemesis, or symptoms of internal hæmorrhage followed by mælena, may occur after gastro-enterostomy. They would indicate that a vessel in the cut edge of the stomach or jejunum had escaped inclusion in the suture, or that the thread had not been drawn tightly enough to occlude the vessel. This accident is said to occur more easily when clamps have been employed during the operation. The treatment must be carried out on the lines laid down on p. 39.

### III. SECONDARY ARTERIAL HÆMORRHAGE

Secondary hæmorrhage is almost always due to septic softening of the wall of an artery, such as may result from an infected ligature, from the exposure of the vessel in a suppurating wound.

or from the involvement of a vessel in an ulcerating malignant growth. The possibility of hæmorrhage must always be borne in mind when suppuration takes place in the near neighbourhood of a large vessel.

The bleeding may be sudden, unexpected, and profuse; or it may give some warning of its approach by the escape from time to time of larger or smaller quantities of blood along with the purulent discharge.

*Treatment.* The hæmorrhage must be temporarily controlled by pressure, either at the bleeding spot or upon the main artery on the cardiac side, or in the case of a limb by the application of a tourniquet. At the same time preparations must be taken for its permanent arrest.

As in primary, so in secondary hæmorrhage, it is essential to deal with the bleeding-point. The only valid reason for not doing so is its inaccessibility. But in secondary hæmorrhage the local conditions are different on account of the septic state of the tissues. The principles upon which such bleeding is to be dealt with are as follows :—

(a) The wound must be thoroughly opened up, and cleansed as far as possible. Free drainage is essential if the suppuration is to be arrested and the risk of further hæmorrhage minimized. No harm can result from irrigation of the wound with some such antiseptic as 1 in 2,000 formalin or with peroxide of hydrogen.

(b) The bleeding-point must be identified and the vessel ligatured. If the hæmorrhage has occurred from an artery in its continuity, the vessel must be tied both above and below the bleeding-point.

Should the application of a ligature prove impossible, either on account of the softness of the vessel wall or on account of the depth of the wound, a pair of artery forceps should be applied, and, if the bleeding is thereby controlled, it should be left *in situ* for forty-eight hours. If neither of these methods is practicable and the hæmorrhage is not very severe, the cautery may be employed, or the wound may be tightly plugged from the bottom with antiseptic gauze.

It is only when none of these local methods prove successful that the main artery is to be tied at a distance from the wound. Sometimes it may be necessary to combine the two methods, namely, ligature of the main vessel and plugging of the septic wound.

## IV. VENOUS HÆMORRHAGE

In most wounds, both accidental and deliberate, the venous hæmorrhage is so overshadowed by the arterial as to be of minor importance. But there are certain instances in which an injury to a vein constitutes the chief feature of the case.

Like arterial, venous bleeding is *primary* if due to laceration or other wound, and *secondary* if resulting from ulceration through the vessel wall.

(i) *External Venous Hæmorrhage*

(a) *Primary.* Large veins in the neck are sometimes wounded in suicidal injuries without bleeding of any consequence taking place from arteries. During operations, especially upon the neck, large veins may be wounded or torn accidentally, and give rise to most alarming hæmorrhage. In excision of certain forms of goitre, the chief trouble as far as hæmorrhage is concerned lies in the great venous plexus spread out over the tumour.

The principles of treatment in the case of the veins are quite different from those upon which the treatment of arterial hæmorrhage is based, because of the difference in blood pressure in the two cases. A wound in a large vein, such as the internal jugular, can be closed by a lateral ligature, or even by suturing, without fear of recurrent hæmorrhage taking place, or of the subsequent formation of an aneurysm. When the wound is deep, and the bleeding-point inaccessible, it is sufficient to apply a firm plug.

A not uncommon accident is laceration of the vulva during pregnancy from the breaking of a urinal upon which the patient is sitting. The bleeding, which may be extremely profuse, is chiefly venous in character, and may be very difficult to control. It is generally a mere waste of time to try to ligature all the bleeding-points, and the best plan is to pass several deep sutures of strong silkworm-gut through the wound, and to tie them tightly.

(b) *Secondary.* This is rare, but sometimes the wall of the lateral sinus, exposed in a foul mastoid wound, gives way and serious hæmorrhage occurs. It is an uncommon event, because the septic process usually causes thrombosis of the sinus before the sloughing of its wall occurs. Should it happen, however, all that is required is to plug the sinus, enlarging the opening in the bone if necessary, in order to secure ease of access. The plug

can readily be secured in place by tucking its free end in between the bone and dura mater at the edge of the bony opening.

The commonest example of secondary venous hæmorrhage is that which takes place from varicose veins. In these cases the skin has become adherent, thinned, and ulcerated over a pouch-like dilatation of the diseased vein, and the slightest injury is sufficient to break through the thinned covering. The bleeding may be most profuse, as the vein may be of great size, and the valves being incompetent the weight of the column of contained blood causes considerable back pressure. The amount of blood lost from such a vein in a few minutes may be enormous, and even sufficient to prove fatal. Fortunately the treatment is extremely simple. All that is necessary is to lay the patient flat upon the back, and to elevate the leg. When this has been done, and the hæmorrhage thereby arrested, the clothing must be removed, and a pad firmly bandaged over the ruptured vein.

#### (ii) *Internal Venous Hæmorrhage*

(a) *Subcutaneous*. When venous bleeding takes place subcutaneously, a hæmatoma is produced, and in regions where the tissues are lax, such as the scrotum, the hæmatoma may attain a very considerable size. In large hæmatomas the source of the bleeding is no doubt arterial as well as venous.

When small, no treatment is required beyond rest, elevation, and the application of cold compresses, and absorption will take place in the course of a few days to a few weeks. If large, or if the skin over it is very thin, secondary septic processes are apt to occur, giving rise to a suppurating hæmatoma. Such a case requires incision, and the treatment appropriate to an ordinary abscess. Even without signs of suppuration, the hæmatoma, if large, should be incised, as this will materially shorten the period of convalescence; but in such circumstances it should be dealt with as a 'clean' case, namely by incision, washing out the clot, and closure without drainage.

(b) *Intraperitoneal* hæmorrhage is often venous rather than arterial, both after operations and injuries. Laceration of the renal veins, mesenteric veins, and even of the vena cava, have all been recorded (see Chapter XV).

(c) *Intracranial* hæmorrhage is sometimes exclusively venous in character, especially in birth injuries, as has been pointed out by Harvey Cushing (see p. 344).

## V. EPISTAXIS

Bleeding from the nose may be due to general or local causes.

*General causes.* It is very common in stout individuals of the plethoric type, in arterio-sclerosis with high blood-pressure, in cirrhosis of the liver, and is especially frequent in hæmophilia. It often occurs about the time of puberty without obvious cause. It occasionally occurs at the onset of the specific fevers, especially typhoid. It is not very common in chronic heart and lung disease.

*Local causes.* It frequently results from blows on the nose, with or without fracture of the nasal bones, and is often seen in fracture of the anterior fossa of the skull. It may be due to ulceration or tumours of the nasal passages or to chronic rhinitis.

*Treatment.* The cause of the bleeding should first be ascertained. When due to general causes epistaxis may be beneficial, and, unless severe, no active local treatment need be undertaken. It will often cease with rest in the recumbent position, and a handkerchief soaked in cold water may be laid across the forehead and nose. Should the bleeding persist a nasal douche of adrenalin solution (1 in 10,000) may be tried. If this fails the nasal cavity must be plugged, and there are several ways of doing this. The simplest method is to introduce strips of gauze wetted with adrenalin solution (1 in 1,000) by means of a probe. The use of a 5 per cent solution of gelatin has also been recommended for this purpose. If available, one of the inflatable rubber bags made for this purpose may be used; this should be introduced empty by means of a pair of curved forceps and then inflated. The posterior nares may be plugged as follows, should the simpler methods prove inefficient. A roll of gauze of appropriate size (Fig. 8) is tied round its middle with a long double silk thread. The side on which the hæmorrhage is occurring having been determined, a soft rubber or gum-elastic catheter is passed along the floor of the nose into the naso-pharynx and then hooked forward into the mouth with the forefinger. The silk thread is tied to the end of the catheter, which is then withdrawn from the nose carrying the silk with it, and the roll of gauze is manipulated into position against the posterior nares. A second plug is then placed against the nostril, and the silk threads tied round it, thus securely blocking both nostril and posterior nares.

Nasal plugs should never be left in position for more than

twenty-four hours, as they become very foul. After their removal the patient should avoid exertion and should not blow his nose for a day or two.

Internally calcium lactate in drachm doses has been recommended, but we are not satisfied that its use has been attended with striking results. In severe or recurrent cases 10 or 20 c.c. of horse serum may be injected subcutaneously.

When due to local causes examination with a nasal speculum will sometimes reveal a single bleeding-point; this may be dealt with locally by the application of the actual cautery after applying a 5 per cent solution of cocaine.

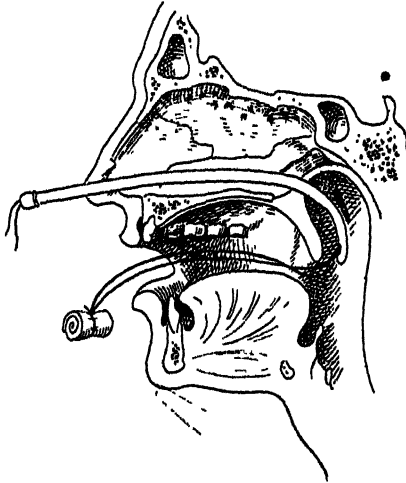


FIG. 8. Method of plugging the nose in severe epistaxis.

Painting the mucous membranes with ferric chloride solution is sometimes efficacious, or the bleeding-point may be touched with chromic acid solution.

## VI. HÆMOPTYSIS

The commoner causes of hæmoptysis are :—

1. Pulmonary tuberculosis.
2. Other lung diseases; bronchiectasis, abscess, gangrene, and tumour of lung. It is occasionally seen at the onset of pneumonia.
3. Cardiac disease, especially mitral stenosis.
4. Thoracic aneurysm, from rupture of the sac into the respiratory passages.

Among the rarer causes may be enumerated ulceration of the larynx, trachea, and bronchi, the blood diseases such as hæmophilia, scurvy, and purpura, the hæmorrhagic forms of the acute infections, and thrombosis and embolism of the pulmonary artery (see p. 226).

*Diagnosis.* If a patient is coughing up large quantities of blood treatment should be carried out at once, without subjecting him to any examination until the hæmorrhage has ceased.

If not severe, the diagnosis of hæmoptysis must first be established. The mouth must be examined, as ulcerated and spongy gums may give rise to bleeding; or blood may trickle down the pharynx from the nose and be coughed up.

Hæmatemesis must be excluded. Patients are often uncertain whether the blood was vomited or coughed up. If definitely vomited it must have come from the stomach, though both with epistaxis and hæmoptysis blood is not infrequently swallowed and subsequently vomited.

The points of distinction between hæmoptysis and hæmatemesis may be put in tabular form (modified from Osler).

#### *Hæmoptysis*

1. Cough or evidence of lung or heart disease often precede the hæmorrhage.

2. The blood is coughed up in successive mouthfuls; some may be swallowed and subsequently vomited.

3. It is often preceded by a sensation of tickling in the throat, and if severe is *followed* by pallor and faintness.

4. The blood is frothy, bright red, and alkaline in reaction. Mucopus may be mixed with it, and the sputum may be tinged with blood for hours or days afterwards.

5. Melæna occasionally follows.

#### *Hæmatemesis*

1. Previous history or obvious physical signs point to gastric, hepatic, or splenic disease.

2. The blood is brought up by vomiting; a very large quantity may be brought up rapidly.

3. Pallor and faintness often *precede* the hæmatemesis.

4. The blood is usually dark and clotted, mixed with food, and of acid reaction. It may be dark or brown and fluid from a longer stay in the stomach, or it may be bright red in a large and rapid hæmorrhage from gastric ulcer.

5. Melæna usually follows.

Having determined that the case is one of hæmoptysis its actual cause should be ascertained. A profuse hæmorrhage naturally suggests the presence of pulmonary tuberculosis, but it may also be due to the rupture of an aneurysm into the trachea or bronchus; to the erosion of a pulmonary vessel in cases of bronchiectasis, pulmonary abscess, or gangrene; or to mitral stenosis.

In most of the cases the previous history will often indicate the cause, or it may be apparent on a superficial examination.

With slighter degrees of hæmoptysis a careful examination may safely be made, and the bleeding may be of value as a hint of the presence of unsuspected disease, e.g. tumour of lung, rather than an indication for the necessity of active treatment; or it may emphasize the necessity for rest and other measures if signs of early pulmonary tuberculosis be found, in view of the possible occurrence of a severe hæmorrhage.

*Treatment.* Active treatment of hæmoptysis is in the large majority of cases only called for in hæmorrhage due to pulmonary tuberculosis. The small streaks of blood so frequently found in the sputum do not call for special treatment. A large hæmorrhage, however, results either from erosion of a vessel or from rupture of an aneurysm of some branch of the pulmonary artery.

Inasmuch as arrest of the hæmorrhage depends upon the formation of a thrombus at the site of the bleeding, measures must be adopted to reduce the rate and force of the heart-beat. The patient must be put to bed, and his excitement and fright at the bleeding, with their resultant acceleration of the heart, may be allayed by assurances of its speedy arrest. For the same reason a hypodermic injection of morphia should be given. Inhalations of amyl nitrite have been strongly recommended, and in view of its power of lowering the blood-pressure it should be tried, especially in severe cases. It is very doubtful whether astringent drugs are of any use.

The patient must be kept absolutely quiet, talking must be forbidden, and a second injection of morphia may be given if the first is insufficient to allay the excitement and restlessness; if necessary, the patient may be kept under its influence for two or three days. If the hæmoptysis is severe no examination of the chest should be made. Stimulants should be avoided. During the first day very little food is advisable, and nothing hot should be given. For the next two or three days a pint or a pint and a half of milk, with bread and butter and an egg, should suffice; after this the ordinary diet may soon be resumed. Saline purges are advisable, and the bowels should be freely opened.



If the hæmorrhage is very severe, or if it recurs, 20 c.c. of horse serum may be injected subcutaneously; anti-diphtheritic serum is more generally available, and answers the purpose equally as well as normal horse serum. If fatal syncope seems imminent, a rectal injection of a pint of normal saline may be tried, and, if necessary, intravenous infusion performed despite the risk of recurrence of bleeding.

Finally, the patient ought to be kept in bed for five or six days, lest the rise in blood pressure brought about by exertion should dislodge the clot formed at the site of hæmorrhage.

## VII. HÆMATEMESIS

The common causes of hæmatemesis are : -

### 1. *Local disease*<sup>1</sup>.

- (a) Ulcer of the stomach or duodenum.
- (b) Carcinoma of the stomach. The bleeding is rarely profuse and often of the 'coffee-ground' type.
- (c) Corrosive poisons.

### 2. *Passive congestion*.

- (a) Cirrhosis of the liver. The blood often comes from the rupture of varicose veins at the lower end of the œsophagus.
- (b) Portal thrombosis.
- (c) Enlarged spleen : especially in splenic anaemia.
- (d) Chronic heart and lung disease.

Among the rarer causes may be enumerated trauma (see p. 293), post-operative conditions (see p. 30), and toxic conditions, as in the malignant forms of the specific fevers, and yellow fever.

The importance of recognizing hæmatemesis following the swallowing of blood and the diagnosis between hæmoptysis and hæmatemesis have been considered in the previous section (p. 36).

The commonest causes of hæmatemesis of such a degree as to demand direct treatment are cirrhosis of the liver and gastric or duodenal ulcer.

*Diagnosis between the hæmatemesis of cirrhosis of liver and that of gastric (or duodenal) ulcer.* A correct diagnosis between these two conditions is of great importance, for though the immediate medical treatment is the same, operation may be called for in the case of hæmorrhage due to gastric ulcer at any moment, whilst it is not to be thought of in cirrhosis of the liver,

in which the blood is in most cases derived from varicose œsophageal veins.

Cirrhosis of the liver occurs commonly at middle age ; a history of alcoholism is usually to be obtained, the liver may be palpable and ' hobnail ' to the touch, the spleen is often palpable, ascites may be present, there is often extreme muscular wasting, the skin is dry and harsh, and a slight jaundiced tint may be present. The facies may be very suggestive : it may be fat and bloated, or the temporal muscles may be wasted ; the skin is sallow or dirty-looking, and clusters of dilated vessels are common. Dyspepsia, loss of appetite, and morning vomiting are frequent.

Gastric ulcer occurs most commonly in young women, in whom cirrhosis is rare, but it is also found in older people, both males and females. A history of pain after food, and vomiting, is commonly obtained. Repeated hæmorrhages and dilatation of the stomach are in favour of gastric ulcer.

In middle-aged adults the diagnosis of a gastric ulcer may be obscured by a history of alcoholism, and in some cases it is extremely difficult to distinguish between the two. Duodenal ulcer is more frequent in middle age and in old people ; pain occurs at a longer interval after food and is often relieved by the next meal ; melæna is a more prominent feature in duodenal ulcer.

Both in cirrhosis and in ulcer the disease may be latent, and a copious hæmatemesis may be the first symptom to attract attention.

Finally, the character of the blood may be helpful. In ulcer the bleeding occurs rapidly from an artery, and may be bright red, whilst in cirrhosis it is usually darker and is more often clotted.

#### *Treatment of Hæmatemesis*

No special directions need be given for treatment of the rarer forms of hæmatemesis. Their cause is often obvious, and direct treatment when feasible may be undertaken on the lines about to be laid down.

1. *In cirrhosis of liver.* The patient must be kept in bed, and a hypodermic injection of morphia is advisable for the same reasons as those described under hæmoptysis. Adrenalin chloride, 20 minims of the 1 in 1,000 solution, may be given for its local action on the œsophagus ; it should not be given hypodermically. As in other forms of severe hæmorrhage, 10 or 20 c.c. of horse serum may be injected subcutaneously. No food must be given by the mouth and ice should not be sucked, for all

swallowing movements must materially interfere with the arrest of hæmorrhage from the varicose œsophageal veins. The bowels should be opened by enemata, and for two or three days rectal injections of normal saline should be given to relieve thirst. After this, food by mouth may be resumed, milk only being given for a day or two.

In the majority of cases a single large hæmatemesis occurs, and the patient is not infrequently somewhat relieved by it. In some cases it is so profuse as to be rapidly fatal; or several hæmorrhages occur at intervals, with fatal result.

With a severe hæmorrhage, or with several hæmorrhages at short intervals, severe collapse occurs, necessitating rectal or intravenous injections of saline.

2. *In gastric and duodenal ulcer.* Bleeding most often results from erosion of a vessel wall. In some cases no ulcer has been discovered post mortem, and it has been supposed that the blood has been derived from a general oozing from the mucous membrane or from minute erosions. Instances are not rare in which fatal hæmorrhage occurs, but in which no coarse ulcer is discoverable at autopsy. Minute examination of the stomach will in some of these cases reveal the presence of a very definite opening in an artery. The following case illustrates this: A man who suffered from repeated severe attacks of hæmatemesis was operated upon, but no ulcer and no bleeding point could be discovered. He died, but no gross ulcer could be found at the autopsy, and it was only after the most minute examination of the arteries in the stomach wall that a definite hole was discovered at an arterial bifurcation. Owing to the arrangement of the gastric mucous membrane such perforations are very difficult to discover. It is probable that many cases of assumed general oozing are in reality arterial perforations.

#### *A. A Single Hæmorrhage*

The patient must be put to bed, and a hypodermic injection of morphia should be given. Adrenalin chloride (20 minims of the 1 in 1,000 solution) may be given by the mouth. No food should be given by the mouth, not even ice to suck. To relieve thirst rectal injections of half a pint of normal saline solution, containing one ounce of dextrose, may be given every six hours. Food by the mouth may be begun in three or four days. After the lapse of these few days of stomach rest H. P. Hawkins recommends small quantities of milk by the mouth as follows:

of a mixture of 21 oz. of milk and 9 oz. of lime-water or barley-water, 2 oz. may be given every two hours for nine doses in the first twenty-four hours. On the second or third day, in the absence of pain, 30 oz. of this mixture may be given, in 5 oz. doses every three hours for six doses, rectal feeding, perhaps on a reduced scale, being continued. Recurrence of pain or vomiting indicates a reduction of the dose, or a slower rate of increase. Hawkins does not advise peptonizing the milk. After three or four days of this diet, rectal feeding can be still further reduced as the milk is increased. Six ounces of milk mixture (28 oz. of milk with 8 oz. of diluent) should now be given every three hours for six doses, and in a day or two 8 oz. of milk mixture (40 oz. of milk with 8 oz. of diluent) every three hours for six doses. To improve the nutritive value of the milk 3 drachms of plasmon may be added to the day's supply of milk, first converting it into a thick paste by stirring it with 5 oz. of tepid water. About fourteen days should be devoted to this milk and plasmon diet. Carbohydrate food, 2 oz., may now be added in the form of arrowroot, bread and milk, rusks and milk, or Benger's food. At the end of the third week two or three eggs may be added, sago or tapioca, milk soup, chicken broth, mutton broth, or beef-tea. Finally, fish and chicken should not be added until at least six weeks have elapsed since mouth-feeding was commenced.

*The alternative Lenhartz method.* Lenhartz contends that the combined rectal and mouth-feeding course of treatment induces such inanition as to delay the healing of the ulcer, and that the risk of the contractions of the stomach induced by food dislodging the clot sealing the bleeding-point is not more dangerous than the risk of the acid gastric juice dissolving such clot. He therefore advises mouth feeding even on the day of hæmorrhage. He keeps the patient in bed for four weeks; an ice-bag is kept over the stomach for two weeks; bismuth subnitrate (gr. xxx) is given three times daily for the first ten days; iron is also given in the form of pills; the bowels are opened by enemata. Food may be given as follows: on the first day 7 oz. of milk and one egg; the milk is increased daily by  $3\frac{1}{2}$  oz., and an extra egg added daily until the patient is taking  $1\frac{3}{4}$  pints of milk and eight eggs *per diem*. From the first to the seventh day the eggs are beaten up, with a little sugar added; subsequently half are beaten and half cooked. The milk and eggs are given in small quantities at a time and are iced.

From the sixth day minced meat is given, raw or almost raw,

starting with an ounce and increasing to two ounces. On the seventh day boiled rice is given. Fish is then added, and by the end of a month the patient may be taking a fairly full diet.

It is claimed that the results obtained by the Lenhartz method are as good as those obtained by the method of rectal feeding, and a certain amount of evidence is accumulating in favour of this view. It is certainly far more pleasant, and nutrition is maintained from the outset.

*Selection of the method to be adopted in an individual case.* The treatment of an active gastric ulcer, whether attended by hæmorrhage or not, is, in view of the attendant dangers and of the unpleasantness and difficulty of the method of rectal alimentation, so important that it may be regarded as emergency treatment throughout. For this reason the two methods have been described in some detail. We think that in view of the general consensus of opinion in England the rule might be adopted that in the immediate presence of hæmorrhage the rectal method should be adopted, but in the absence of hæmorrhage the Lenhartz method is worthy of trial.

#### *B. Very Severe or Repeated Hæmorrhage*

It is exceedingly difficult to decide when surgical aid is necessary, inasmuch as more than 90 per cent of cases recover, or at least the attack of hæmorrhage is brought to an end, without operation. The difficulty is increased by the fact that if operation is to have a fair chance it must be undertaken before the patient is *in extremis*. The following case is an instance in point: a young man had been steadily bleeding from the stomach for three days. When at last it became obvious that medical measures were of no avail, surgical aid was called in. The patient was blanched to an extreme degree, and almost pulseless. Whilst intravenous infusion was being performed, the abdomen was rapidly opened, and the stomach incised. In the floor of a chronic ulcer an artery of some size was bleeding vigorously, and such was its situation in the cicatricial tissue that it was held open and incapable of spontaneous closure. The vessel was ligatured, and the wounds in stomach and abdomen rapidly closed. The operation, however, had been performed too late and the patient never rallied.

Our own opinion is that, if the hæmorrhage is so copious in a first attack as to suggest that a large artery has been opened,

operation should be performed at once, but that in other cases medical treatment should be given a fair trial, short of letting the patient bleed to a dangerous degree; and that if these measures fail, or if a second copious hæmorrhage occurs, operation should be undertaken.

*Operation for hæmatemesis.* The abdomen is opened by a vertical incision immediately below the left costal margin, about five inches in length, the rectus muscle being divided in the direction of its fibres. The stomach is thus exposed, brought up to the wound, and most carefully packed off from the general peritoneal cavity with gauze. Careful palpation of the stomach is next made, in order to ascertain whether a chronic ulcer is present, so that the opening into the organ may be made as close to the ulcer as possible. When no such guide exists, the opening is most conveniently made near the middle of the anterior surface of the stomach by an incision about three inches in length, so as to open it midway between the two curvatures. The interior can then be examined both by palpation and inspection. For the latter purpose a large Fergusson's vaginal speculum may be introduced, and, with the aid of a forehead light, the interior should be carefully examined. The greater part of the interior may be inspected by pushing with a finger outside the stomach successive areas of the mucous membrane up to the wound. This is best done by introducing the finger into the lesser sac through a small opening in the gastro-colic fold of peritoneum. If the bleeding-point is seen, an attempt must be made to seize it with forceps and ligature it. The ligature should include a good deal of the surrounding mucosa. If the ulcer is free from adhesions to neighbouring structures, a strong ligature may be applied in such a manner as to include the whole ulcer and surrounding coats of the stomach. If it is possible neither to tie the bleeding vessel in the floor of the ulcer, nor to ligature the whole diseased area *en masse*, the hæmorrhage must be arrested by passing a stitch so as to include the bleeding-point.

If no gross ulcer is found, a most minute examination of the mucous membrane should be made with the hope of finding an eroded vessel. If no hæmorrhage is taking place at the time of operation, it will be a very difficult matter to find the site of hæmorrhage: but the importance of so doing is so great, owing to the risk of recurrence of hæmorrhage, that every care should be taken to find the vessel. If the blood appears to come from a general oozing over the gastric surface, the mucous membrane

may be swabbed over with adrenalin solution. The operation is completed by closing the incision in the stomach by a double row of sutures, the first passing through all the coats, and the second including peritoneum only. Gastro-enterostomy is often performed whether the bleeding-point has been secured or not. This introduces additional shock, and is a method of treating the ulcer rather than the hæmorrhage. If the bleeding point has been secured we are of opinion that gastro-enterostomy should not be performed at the same time, at any rate as a routine measure. Clearly there are some cases where the ulcer is so situated that the measures necessary to secure arrest of the hæmorrhage will inevitably produce pyloric obstruction. In these cases gastro-enterostomy must be done in spite of the additional risk entailed.

#### VIII. HEMATURIA. See p. 329.

#### IX. HEMOGLOBINURIA

This is a condition of rare occurrence, but it should be borne in mind lest it be mistaken for hæmaturia. It is sometimes associated with Raynaud's disease, and exposure to cold is often the exciting cause. Red corpuscles may be completely absent from the urine, the hæmoglobin having been discharged from them.

The patient should be put to bed, when the attack will often cease immediately. He should always be warmly wrapped up and should avoid exposure to cold.

#### X. HEMOPHILIA

In a patient who is the subject of hæmophilia, hæmorrhage sometimes presents a problem of the greatest difficulty. The cause of the disease still remains unknown, but its well-recognized hereditary nature and the character of the bleeding usually render diagnosis easy. There are three types of bleeding in hæmophilia, namely, *spontaneous*, *traumatic*, and *arthritic*. It is with the first two that we are here concerned. The spontaneous hæmorrhages occur chiefly from the mucous membranes, and take the form of epistaxis, hæmaturia, hæmatemesis, and melæna. Traumatic hæmorrhage may take place from the most trivial wound, and may be so persistent as to result fatally in spite of every endeavour to arrest it. On the other hand, the tendency to spontaneous cessation, even when the patient seems to be on

the point of death, renders it difficult either to give a prognosis or to ascribe a proper value to the action of any particular remedy that may happen to be employed.

*Treatment.* No plan which involves the making of a fresh wound, such as acupressure or stitching, should be employed. Pressure upon the bleeding area, where such is practicable, should be employed, firmly but gently, otherwise sloughing or subcutaneous hæmorrhage may be caused. If the bleeding occurs from a cavity such as a tooth socket, plugging should be tried. Of the various styptics that have been used, sometimes one, and sometimes another, appears to be efficacious. One of the best is adrenalin, but hamamelis, peroxide of hydrogen, and 5 per cent solution of gelatin may also give good results. Ferric chloride is a time-honoured styptic which we have never seen to have the least effect in hæmophilia. In hæmophilic epistaxis the nose may have to be plugged, and the gauze used for this purpose should be wetted with adrenalin solution. There is some ground for believing that the internal administration of tincture of hamamelis may have a good effect. Twenty-grain doses of chloride or lactate of calcium are recommended by some, but it should be remembered that these salts, if given in excess, diminish rather than increase the coagulability of the blood. When the patient is suffering severely from loss of blood, rectal injections of saline should be given, and he should be allowed to drink fluid freely.

The use of normal horse serum given either subcutaneously (10 c.c.) or per rectum (25 c.c.) has been recommended, and may well be tried in an obstinate case. Anti-diphtheritic serum is commonly more readily accessible, and is stated to act with equal efficiency.

#### XI. UTERINE HÆMORRHAGE

With the excessive loss of blood from the uterus in the later stages of pregnancy and after parturition we are not concerned. These are emergencies with the diagnosis and treatment of which the practitioner must of necessity be familiar, and if he requires to refresh his memory he will naturally turn to one of the obstetrical textbooks in which they are fully discussed.

It is well, however, to mention briefly certain forms of severe and urgent uterine hæmorrhage with which he may not be so familiar and which would have to be sought for in the gynecological text-books.



(a) *Post-operative.* After an ordinary curetting of the uterus very severe hæmorrhage may occur either immediately or after an interval of some days. The treatment consists of pulling down the uterus by means of a volsellum forceps on each lip of the cervix, irrigating the uterine cavity with saline at 120 F., and plugging it firmly with gauze.

(b) *After abortion* in the earlier stages hæmorrhage may occur to an alarming and dangerous degree, either at the time or after an interval of some days. The treatment is the same as that just described, with the addition, of course, of first removing any portions of the ovum which may still remain in the uterine cavity.

(c) A submucous fibroid or a carcinoma of the uterus may occasionally cause sudden and alarming hæmorrhage; a similar line of treatment is to be adopted in these cases also, namely hot irrigation and plugging.

## CHAPTER IV

### WOUNDS

It is beyond the scope of this book to enter into the details of general surgical technique. In hospital, and often in general practice, facilities are readily available for the carrying out of modern surgical methods, whilst in emergencies elsewhere the practitioner is obliged to rely upon such methods of cleanliness and disinfection as may be available, or as his ingenuity can, in the particular circumstances, devise. Soap and water, common salt for making saline solution, and vessels in which instruments can be boiled, are almost always available, so that those whose training has taught them to rely upon washing and boiling in routine surgical work are less at a loss in cases of emergency under adverse conditions than those who have been taught to pin their faith upon the use of antiseptic solutions.

Some of the operations mentioned in the succeeding chapters are such as should never be attempted unless the prospect of maintaining asepsis is certain, as, for instance, operations upon simple fractures. In other instances the urgency of the case demands that operation should be undertaken without delay, even in circumstances which appear to be most adverse to asepsis.

#### A. PREPARATIONS FOR AN EMERGENCY OPERATION IN A PRIVATE HOUSE

The sources of wound infection at an operation are :—

- (a) The hands of the operator or assistants.
- (b) The patient's skin.
- (c) Instruments, sponges, and ligatures.
- (d) Dust from the air.

The preparations for an operation in a private house aim at avoiding these sources of infection, and at the same time providing such facilities as may be available for the convenience of the surgeon in the actual performance of the operation. The steps to be taken with these objects in view will be briefly indicated.

1. *Room.* The room should be large and light, and warmed by a fire in an open grate. There should be as little disturbance of the furniture and hangings as possible, because otherwise dust will be scattered in the air. An undisturbed room with carpet and curtains in place is better than a carpetless room in which the air is full of dust. Clean dust-sheets, or newspapers, should be spread over the floor under and around the operating table.

2. *Tables.* A kitchen table is usually the most suitable one available; it should not be too wide, and should be long enough to accommodate the patient comfortably. If a sufficiently long table is not at hand, two or more smaller ones can be placed together so as to form a convenient operating table. Stability is essential.

The table must be covered over with at least two layers of blanket, protected with macintosh. If macintosh is not available, newspapers answer the purpose quite well. This is covered with a clean sheet, a pillow is placed at one end, and another blanket provided to cover the patient during the operation. Three small tables will be required in addition to the operating table, one for instruments, another for dressings, and a third for the anæsthetist's apparatus. One chair can be made to serve, if such tables are not available.

3. *Vessels.* If no special bowls and basins are available, the ordinary domestic utensils can be made to answer perfectly well. Several ordinary bedroom jugs should be scalded out with boiling water, filled with boiled water, and covered over with clean towels. Both hot and cold water will be required.

Three ordinary hand-basins should be washed, scalded with boiling water, and placed, bottom upwards, upon clean towels spread upon a table. One or two small jugs may be required, and should be treated in the same way. Two or three small bowls, such as soap-dishes or pudding-basins, should be provided; these can be boiled in a large saucepan or fish-kettle. A receptacle for dirty swabs must also be provided. A couple of clean nail-brushes should be sterilized by boiling for ten minutes.

4. *Towels.* At least a dozen clean hand-towels should be prepared in the following manner: they should be folded up and packed inside another towel, in packets of four, and boiled in a large saucepan or fish-kettle for ten minutes. The packets should then be transferred to one of the basins, and only opened and wrung out as required.

With some such preparations as these, and with the following

precautions against infecting the operation area, the surgeon need have no fear, on the score of asepsis, about undertaking any operation of urgency in a private house. In hospital stricter precautions are both needed and practised, because the air of a hospital is more likely to contain pathogenic organisms than that of a private house.

5. *Sponges.* Perfectly satisfactory emergency sponges or swabs can be made by cutting squares of fourfold gauze, and rolling them into a ball. These can be sterilized in the same manner as the towels, by putting a quantity of them inside a towel, boiling the package for a quarter of an hour, squeezing out the water by using the towel in which they have been boiled as a wringer, and using them direct from the package.

6. *Instruments.* These should be boiled for ten minutes in water to which common washing soda, a drachm to the pint, has been added. A fish-kettle makes an excellent emergency sterilizer. Knives should be wrapped in a piece of gauze or lint before being boiled, to prevent blunting.

7. *Hands.* The hands of the surgeon and his assistants must be washed with the greatest thoroughness, using soap, hot water, and the sterilized nail-brush for at least five minutes, and the washing should include not only the hands but the whole forearms. If a supply of methylated spirit is available, the hands should be dipped in it for a couple of minutes, and then again rinsed in water.

8. *Patient's skin.* The patient's skin must be cleansed in the same manner, and with the same scrupulous care, for a wide area around the proposed site of operation, hairy parts having first been shaved. It is often possible to give the patient a hot bath, and to clothe him in clean body-linen, whilst preparation is being made for the operation.

The *Iodine method* of preparing the skin is an excellent one, and for many emergency procedures is to be preferred to that just described. A two per cent solution of iodine in rectified spirit is painted over the area to be sterilized, with a large camel-hair brush, and allowed to dry in. This should be done, when possible, a couple of hours before the operation, and repeated immediately before beginning. It is essential that the skin should be dry when the application is made, otherwise much of the penetrating effect of the solution is lost. For such cases as crushed fingers and toes, and for emergency operations on the scalp, the method is particularly good, as a single scrubbing up with ether soap and water, and the application of watery

solutions of antiseptics cannot possibly render the skin aseptic under such circumstances.

9. *Saline solution.* This is prepared by adding a teaspoonful of common salt to each pint of water and sterilizing by boiling. If it is to be used for intravenous infusion, and has to be prepared hurriedly from ordinary household salt, it is wise to filter it through a piece of sterilized gauze or muslin, so as to get rid of any possible foreign matter. The best way is to make a concentrated solution of known strength, say ten teaspoonfuls of the salt to half a pint of water, so that an ounce of the strong solution made up to a pint with boiled water makes a salt solution of the right strength, or 'normal saline'. It is easier in this manner to prepare a large quantity as required, and also it is easier to get it of the right temperature, which, for infusion, is 105° F.

#### B. TREATMENT OF ACCIDENTAL WOUNDS

In the first place, hæmorrhage having been temporarily arrested by tourniquet or pressure, all instruments, ligatures, and towels are to be sterilized, and the hands of the surgeon and his assistants cleansed with precisely the same scrupulous care as for an ordinary operation. The assumption that the wound is already infected offers no excuse for carelessness in any single detail, and cannot be too severely condemned. The probable presence of micro-organisms in the wound is no excuse for the introduction of others, probably of a different kind. The wound itself should be covered over with a piece of sterile gauze, and the skin for a wide area around shaved and thoroughly cleansed with soap, nail-brush, and an abundance of hot water, followed by ether, alcohol, or turpentine, all of which serve to remove grease and dirt. In many cases the iodine method of disinfection will be found very useful (p. 49). The solution must not be allowed access to the wound itself, on account of the necrosis which it would produce.

After rendering the surrounding skin as clean as possible, the wound is to be dealt with. It should be freely irrigated with hot saline solution, and any loose or badly bruised pieces of tissue are to be removed with scissors and forceps. It is often advisable to pare away the bruised or lacerated skin edges, so as to provide a clean-cut margin for suture. When the wound has been cleansed as thoroughly, and at the same time as gently as possible, and all bleeding points have been secured, the skin edges should be brought together with sutures, but without tension. If the skin cannot be approximated without

tension, or if there has been much loss of skin, the wound must be left open, partly or wholly, according to the particular circumstances. If much oozing is anticipated, or if the wound is deep or badly lacerated, drainage for a day or two is advisable. The best method of drainage in these cases is to insert one or two glass tubes, such as Kocher's (Fig. 9), between the stitches after closure of the wound. Shallow clean-cut wounds need no drainage, and they will usually heal by first intention, especially in vascular regions like the face.

A wound should never be sutured without making a thorough examination to ascertain whether any deep structures have been injured, and to see that no foreign bodies, such as pieces of broken glass, remain behind. This examination must be conducted with the utmost cleanliness and gentleness, lest infection be carried into the wound or additional damage be done. In the case of deep penetrating wounds, and of bullet wounds, examination with the probe is usually to be deprecated, because of the danger of introducing infection.

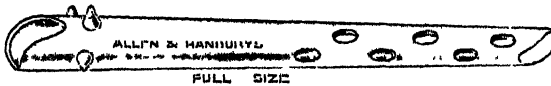


FIG. 9. Kocher's tube.

*After-treatment.* Many accidental wounds heal by first intention, or, if there has been loss of tissue rendering complete closure impossible, they may heal partly by first intention and partly by granulation, without giving rise to any constitutional disturbance.

When the tissues are unable to cope with the infection, either on account of its nature or because of some unfavourable constitutional condition, both local and general symptoms will manifest themselves, depending upon the kind of organism present. Some specific organisms may have gained a foothold, such as those of erysipelas, tetanus, or emphysematous gangrene (see Chapter VI). More often suppuration will ensue, varying in severity and extent from a mild discharge of pus with little or no constitutional disturbance, to rapidly spreading cellulitis and lymphangitis with symptoms of intense septic poisoning.

The details of treatment of a suppurating wound must vary with its situation, but the general principles are the same in all. The wound must be freely opened up by removing any stitches, and if necessary enlarging it or incising the tissues around.

The freest possible drainage is essential. A deep wound may be frequently irrigated with some mild antiseptic, the most useful and most generally applicable form of which is peroxide of hydrogen. In the intervals hot fomentations of boiled lint should be applied. When the situation of the wound renders immersion in a bath possible, this form of treatment is the best that can be adopted. Care must be exercised that the parts do not become sodden, as this would retard healing, so that, as soon as the acute inflammation has subsided and the general symptoms show that septic absorption has ceased, dry dressings should be substituted. At the same time, good feeding, tonic treatment, and plenty of fresh air are indicated.

### C. WOUNDS IN SPECIAL SITUATIONS

Wounds involving special structures are for the most part dealt with regionally in the succeeding chapters. There are two common and important injuries having no place elsewhere which will be considered here.

#### (i) DIVIDED TENDONS

Cuts about the wrist are amongst the most common of accidental wounds, and require special care if the function of the hand is to be fully preserved. A mistake not infrequently made is that of putting the patient under an anæsthetic before a full examination has been made for injury to tendons and nerves. Unless a thorough investigation is made whilst the patient is conscious, the gross error may easily be committed of overlooking a divided ulnar or median nerve, or a divided tendon. In order to ascertain whether a nerve has been injured, the movements of the fingers and thumb normally brought about by the short muscles of the hand must be tested and the cutaneous sensation carefully examined.

In investigating the sensation of the skin two chief sources of possible error must be kept in mind: (a) If only rough tests are employed, the retention of deep sensation may cause the fact of loss of tactile sensation to be overlooked. Deep sensibility (to pressure) may remain intact even though the main nerves have been divided. The skin must therefore be tested by something which gives touch and not pressure sensations, such as a camel-hair brush or a wisp of cotton-wool. (b) The trunk of the ulnar nerve may have been divided below its dorsal branch, which comes off about two inches above the wrist. Escape of this

dorsal branch means that cutaneous sensation is retained over the dorsal aspect of the little and ring fingers, a fact which may give rise to the erroneous supposition that the whole nerve has escaped.

The state of the tendons is tested by making the patient put the forearm muscles into action, remembering that the flexor sublimis acts upon the first interphalangeal joint, and the flexor profundus upon the terminal interphalangeal joint.

*Treatment.* For divided nerves, see p. 355. When tendons have been completely severed, considerable retraction usually takes place, so that it may be necessary to enlarge the wound for two or three inches or more upwards, in order to find the proximal

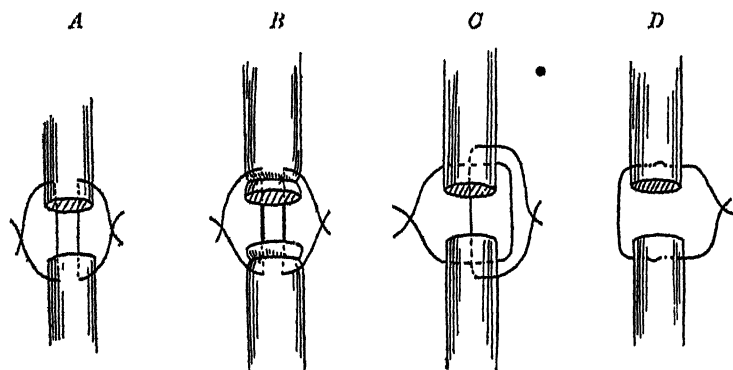


FIG. 10. Various methods of suturing a divided tendon.

ends. The necessity for such extension of the wound can often be avoided by making use of the following simple manœuvre. The muscular mass is squeezed from the elbow towards the wrist, as if being flattened by a rolling-pin; the retracted proximal ends of the tendons are thus pushed down into the wound, when they can be seized with forceps.

When more than one tendon has been severed, the corresponding ends must be carefully identified before any stitching is begun. The suture may be of catgut, but silk is more generally useful, and a round-bodied needle is to be preferred. The method of passing the stitch is important, for if it is passed as in *A* (Fig. 10) it is liable to tear out when any strain is put upon the tendons. It is a simple matter to overcome this difficulty—any of the methods *B*, *C*, *D*, or some modification of them, will effect a good and strong junction.

After suture, the hand should be dressed with the fingers and



wrist flexed or extended, as the case may be, to relax the sutured tendons. Massage and movements should be begun as soon as the wound has healed.

[Sepsis following upon the suture of accidentally divided tendons must be treated most energetically with free drainage and the continuous boracic bath. It is almost certain to be followed by sloughing of tendons with subsequent loss of function.

### (ii) C'ut Throat

The gravity of this injury depends chiefly upon whether the air-passages have been opened into, or a large vessel wounded. The latter complication is, owing to the depth at which the great vessels lie, of uncommon occurrence, and when it does occur proves rapidly fatal. Apart from the carotid and jugular vessels themselves, the injury may involve a large branch or tributary, from which fatal hæmorrhage may occur, or through which air may be sucked into a vein. In many cases the incision does not pass deeply enough either to wound a large vessel or to open into the air-passage, the injury then amounting to nothing more than a wound of the soft parts to be treated upon general lines. But even in a case where the actual wound is trivial, the outlook may be grave, owing to the mental depression leading up to, or consequent upon, the circumstances of the injury; the shock, indeed, is often quite disproportionate either to the size of the wound or to the loss of blood.

The common situations of the deeper wounds are as follows:

- (a) Through the thyro-hyoid membrane, opening into the pharynx.
- (b) Through the thyroid cartilage, opening into the larynx.
- (c) Through the crico-thyroid membrane.
- (d) Below the larynx, into the trachea.
- (e) Above the hyoid bone into the root of the tongue.

Of 114 consecutive cases admitted to St. Thomas's Hospital, 34 presented skin wounds only. Of the 80 cases in which the incision had opened the air-passages, 41 involved the thyro-hyoid membrane, 18 the thyroid cartilage, 9 the crico-thyroid membrane, 10 the trachea, and 2 were above the hyoid bone. Of the whole number only 36 proved fatal, showing a mortality of 31·5 per cent.

The *immediate* dangers are those of suffocation and hæmorrhage, to which may be added the possibility of the entrance of air into a wounded vein, a complication which has occasionally

been observed. If a carotid artery or the internal jugular vein has been opened into, death will speedily take place; but not infrequently some branch of the external carotid is divided, from which a large amount of blood may be lost, and yet spontaneous temporary cessation of the hæmorrhage may take place. This points to the necessity of a thorough examination of the wound for injured vessels, in order that the risk of the hæmorrhage recurring as the syncope passes off may be guarded against. The accident of entrance of air into veins is dealt with on p. 227. Suffocation may be brought about by the entrance of blood or vomitus into the air-passages, or by œdema of the larynx.

The more *remote* dangers are those of sepsis, including secondary hæmorrhage, septic broncho-pneumonia, and cellulitis of the neck which may extend into the mediastinum. Septic pneumonia results either from the inhalation of blood and vomitus immediately after the injury, from the subsequent inhalation of septic material from the wound, or from inability of the patient to keep particles of food and mucus out of the larynx on account of loss of sensation from injury to the superior laryngeal nerve.

*Treatment.* Preparations for operation must be made immediately. In the meanwhile the shock must be treated energetically (Chapter I), and in all probability intravenous saline infusion will be required. The surgeon must be prepared to deal with the recurrent hæmorrhage which these measures are apt to bring about.

If dyspnœa is a prominent symptom, tracheotomy should be performed as a preliminary measure. Indeed in most cases in which the air-passages have been wounded it is best to open the trachea and to keep in a tube for a few days. Sometimes the wound itself, when situated below the larynx, affords a convenient opening for the introduction of the tracheotomy tube, and should then be taken advantage of. It is advisable to plug the trachea above the tube, so as to prevent the entrance of blood or other material during the manipulations of the wound.

The wound must next be opened up, enlarged if necessary, and thoroughly cleansed. The unavoidable disturbance will often restart the hæmorrhage, and this has the advantage of enabling the bleeding points to be identified and securely ligatured. When the wound has been cleansed and all bleeding and oozing stopped, the opening into the air-passage, unless deliberately used for a tracheotomy tube as suggested above, must be securely closed with fine silk or catgut stitches, taking care that the needle does not pass through the mucous membrane. It sometimes happens

that a calcified thyroid cartilage has to be dealt with, in which case it may be necessary to use a drill for the introduction of the sutures. Any divided muscles are then to be drawn loosely together with silk or catgut sutures, and the wound packed with gauze. If the skin incision is very large, it may be partially closed. It is most important that no part of the wound except the actual opening into the air-passage should be closed too securely, lest emphysema and spreading suppuration should follow. If the oesophagus has been wounded it must be closed as securely as possible, and a drainage tube left in the wound reaching down to it.

*After-treatment.* The patient must be put back to bed and kept warm with blankets and hot bottles. He should be propped up almost in a sitting position, the head being flexed and supported with sand-bags. The head of the bed should be protected with a tent, in which the air is kept moist by means of a steam kettle. He must, for the first few days, be the sole care of a nurse, and afterwards must be continually watched by an attendant to guard against any further attempt at suicide (see p. 104). The feeding is a matter of importance, and often of some difficulty. If the cut has passed above the hyoid bone, swallowing may be impossible; and if the pharynx has been opened, food may, on attempting to swallow, pass out through the wound. Moreover, when the superior laryngeal nerve has been damaged in a wound of the thyro-hyoid membrane, the commonest situation of cut throat, there will be no laryngeal reflex to keep particles of food out of the trachea. Most cases, therefore, require artificial feeding.

## CHAPTER V

### ACUTE INFECTIVE DISEASES

#### I. GENERALIZED PYOGENIC INFECTIONS

THE term *septicæmia* is used to designate any condition in which the blood is invaded by bacteria, and the term *bacteræmia* is synonymous with it.

(a) *Septicæmia with an obvious site of local infection.* Septicæmia may develop in the presence of an obvious seat of local infection such as a septic wound, carbuncle, gonorrhœa, or an infected uterus after labour. Toxins are generated by the bacteria, and owing to the number that may grow under the favourable conditions presented by the blood, which as regards its temperature and quantity affords a favourable medium for bacterial growth, the constitutional symptoms are often extremely severe, and a fatal result is not uncommon.

In a local infection without microbial invasion of the blood the amount of toxin is necessarily much smaller and the general symptoms are less severe.

*Symptoms.* The onset is usually signaled by a chill or a definite rigor. The temperature rises and often shows marked remissions. The patient rapidly becomes very ill with extreme prostration, dry tongue, rapid pulse, diarrhœa, and often insomnia and delirium. The skin may be slightly jaundiced and petechial hæmorrhages are not uncommon. Occasionally the disease runs a more chronic course.

(b) *Septicæmia without an obvious site of local infection.* The commonest pathogenic organisms giving rise to this condition are the *streptococcus pyogenes*, the *staphylococcus aureus*, and the *pneumococcus*. The *gonococcus* occasionally gives rise to a general septicæmia, and some other affections, such as enteric fever, are in reality septicæmias, for the typhoid bacillus can be found in the blood in the earlier stages of the disease.

The symptoms are practically the same as those just described, but ordinary examination may fail to reveal the existence of a primary focus of disease capable of accounting for the condition.

(c) *Pyæmia.* In pyæmia organisms capable of giving rise to suppuration are distributed by the blood-stream and arrested in various regions, where they cause inflammation or suppuration. A fragment of clot from a thrombosed vein may act as a

passive carrier of the bacteria, or there may be a general microbial invasion of the blood (septic pyæmia). The organisms most commonly met with are the streptococci and the staphylococci, but the pneumococcus, gonococcus, bacillus coli, bacillus typhosus and bacillus influenzae are occasionally found in cases of pyæmia.

*Symptoms.* These form a symptom complex which depends upon the existence of some primary infected organ or tissue and on the development of embolic inflammation. There may or may not be a general microbial invasion of the blood in addition. The symptoms must obviously vary and depend upon four factors: (1) The function and importance of the region primarily affected. (2) The nature of the pathogenic organism. (3) The function and importance of the regions or organs the sites of embolic infarctions. (4) The presence or absence of septicæmic symptoms from microbial invasion of the blood.

Thus malignant endocarditis may give rise to infarction of the kidneys with renal pain, hæmaturia, and suppuration; intestinal ulceration to suppurative pyelophlebitis; osteomyelitis to pulmonary abscess, empyema, or pericarditis.

Generally speaking a septic focus gives rise to metastatic phenomena in the region through which its venous outflow first passes; this rule holds generally but not absolutely, for instance bacteria derived from an osteomyelitis may pass through the pulmonary capillaries and settle somewhere in the systemic circulation. Ulcerative endocarditis may be a primary focus, and give rise to secondary metastases, but may itself be a secondary pyæmic infection, and subsequently act as a second primary focus.

*Diagnosis.* Many of the important factors in the diagnosis of septicæmia and pyæmia are included in the above remarks. The presence of a primary focus of infection is the most reliable guide. Cultures taken from such a focus will often disclose the particular variety of pathogenic organism present, but the essential organism may be lost sight of owing to the secondary growth of other organisms. In doubtful cases, and in those presenting no obvious primary focus, a blood-culture should be made, and if any pathogenic organism be detected it may be safely regarded as the cause of the septicæmia or pyæmia.

*Technique of blood-culture.* About 5 c.c. of blood are required. The skin over the front of the elbow should be thoroughly washed with soap and water and subsequently with ether.

A glass syringe should be thoroughly boiled in about 3½ oz. of water containing 8 grains of sodium citrate. This drug may be conveniently kept in tablet form. About ½ c.c. of the fluid is

drawn into the syringe for the purpose of delaying clotting. A bandage is tied round the upper arm to render the veins prominent, and the needle of the syringe is thrust into any convenient vein with its point directed towards the patient's hand. The syringe is then filled with blood, which should be expressed directly from the syringe into several broth tubes and taken to a pathological laboratory. If it is necessary to forward them by post, gelatin tubes should be used; the gelatin is melted, inoculated with the blood, allowed to solidify, and then posted.

*Treatment.* In the treatment of septicæmia and pyæmia the first essential is the thorough surgical treatment of any accessible primary focus of disease and of any embolic abscess. In pyæmia the source of the septic thrombi must be dealt with radically, so as to prevent the entrance of any further supply into the circulation. Generally speaking, amputation is essential in the case of a limb in the presence, for instance, of a septic compound fracture or an acute primary osteomyelitis; when this is impracticable ligation of the main vein on the cardiac side of the primary lesion is indicated (see lateral sinus pyæmia, Chapter XXI). But in the absence of any obvious primary focus, or when it is inaccessible as in the case of malignant endocarditis, the best method of treatment is the use of the appropriate antitoxic serum or vaccine, or of both, after the determination of the specific micro-organism.

Having determined by bacteriological cultures the nature of the organism, a full dose of the related serum should be given pending the preparation of an autogenous vaccine from the patient's blood. As soon as this has been done the vaccine treatment should be commenced. If the blood-culture yields a negative result, the use of stock vaccines or sera is permissible; it is well in such cases to use a multivalent serum.

The question of dosage is a difficult one. R. W. Allen recommends giving a minimal dose (at the top of an oscillation in the temperature) of ten million either of staphylococcus aureus, streptococcus, or pneumococcus, whichever is indicated. If the pulse and temperature show no improvement at the end of twenty-four hours, a dose of double the size should be administered, and again doubled after a second period of twenty-four hours if no improvement occurs.

The general, as apart from the specific, treatment is not unimportant. Cardiac, pulmonary, and renal complications are common in cases of acute septic poisoning. These are to be guarded against as far as possible, and treated on general symptomatic principles when they do occur.

## II. LOCAL PYOGENIC INFECTIONS

The constitutional symptoms common to the following conditions are those of toxæmia or septic intoxication, as distinct from the foregoing conditions of septicæmia; they naturally vary with the severity and character of the local infection, and subside directly absorption from the local focus ceases. But even an apparently trivial infection may, under unfavourable conditions, give rise to a true septicæmia.

1. *Acute Abscess.*

It need hardly be said that all abscesses, wherever they occur, require early incision. Some abscesses in special regions are dealt with in other chapters; others will be mentioned individually in the following paragraphs. It is only necessary here to mention a few points in connexion with abscesses in general.

A common fault in their treatment is too small an incision. No abscess is properly opened unless at least one finger can be introduced into its cavity, nor properly drained by a tube of less diameter than that of the little finger. In most situations these conditions are capable of fulfilment; in a few they are not, and it is in these circumstances that troublesome sinuses are apt to occur.

Regard must be had to the anatomical position of the abscess, and the incision so planned as to avoid nerves, vessels, and other structures. In most cases the circumstances are such as to allow of a very free opening, but in others, such as deeply situated collections of pus in the neck, axilla, and popliteal space, the anatomical relations render a free incision impossible. In such circumstances the classical method of Hilton has to be employed, which is as follows: an incision of reasonable length is made through the skin and deep fascia, and a pair of sinus forceps is then gently insinuated into the tissues until the pus is reached. The blades are then separated so as to enlarge their track by stretching and displacing the important structures. If possible, the finger should be thrust along the track, so as to enlarge it still further and to break down any septa within the abscess should the cavity be a loculated one, and also to allow a drainage tube of reasonable size to be introduced. The tube must not be retained too long in the wound, as it may itself produce a sinus and delay healing.

With regard to the kind of drain used, it may be said at once that strips of gauze, bundles of horsehair, and tubes of small calibre usually act, not as drains but as corks, and are worse than

useless. The common rubber tube, provided that its lumen is large enough, is the best form of drain, and even that requires clearing from time to time of the thick coagulated pus which tends to choke it. A good plan is to place a fine wick of gauze down the middle of the tube; the changing of the wick from time to time will keep the lumen clear.

### *Abscess in Special Situations*

(a) *Tonsillar abscess* (quinsy). Few local suppurations cause more pain, discomfort, and severe constitutional symptoms than abscess in or around the tonsil. Swallowing may be so interfered with as to necessitate artificial feeding, whilst in some cases serious dyspnoea occurs. If neglected, the pus may make its way into the cellular tissue of the neck rather than burst into the mouth. Early incision is therefore imperative, and the relief afforded is most gratifying.

*Operation.* The mucous membrane should first be painted with cocaine, or, better, novocaine and adrenalin. A narrow knife, with its blade so protected by winding strapping around it that only a third of an inch projects, is then taken, and, the mouth being held open with a gag, is plunged into the most prominent part of the inflamed tonsil, and made to cut downwards and inwards (Fig. 11). It has been recommended that the incision should bisect an imaginary line drawn from the base of the uvula to the last molar tooth. In those cases where the anterior faucial pillar is spread out over the tonsil, the incision necessarily passes through that structure. If pus does not at once escape, a pair of sinus forceps should be passed into the incision and gently moved about until the pus is found. The patient should be sitting up during the operation, ready to eject the pus as soon as it appears in the mouth.

The after-treatment is mainly symptomatic. An antiseptic gargle must be used frequently, and hot fomentations to the neck will be found to afford much comfort.

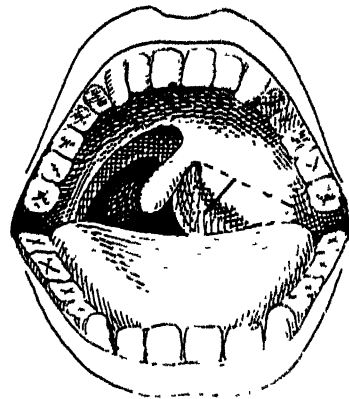


FIG. 11. Incision for tonsillar abscess.



(b) *Alveolar abscess.* A narrow guarded knife or tenotome is used, and the patient should be seated, facing a good light. The knife should always be carried towards the jaw, and not outwards towards the cheek. In the case of the lower jaw it is possible, by cutting too deeply, to wound the facial artery, the situation of which, as it winds over the body of the jaw just in front of the masseter muscle, should be borne in mind.

Apart from such an accident the bleeding, although free, need cause no alarm; it will soon cease if the mouth is well rinsed with water as hot as the patient can bear; only occasionally is it necessary to resort to plugging.

(c) *Retropharyngeal abscess.* With the chronic form which is almost invariably due to tuberculous disease of the upper cervical



FIG. 12. Opening a retropharyngeal abscess.

vertebrae we are not here concerned, though it sometimes presents itself as an emergency condition by giving rise to dyspnoea. It may become acute from secondary infection with pyogenic organisms. The acute variety is caused either by direct pyogenic infection of the prevertebral cellular tissue from injury sustained from pointed objects like fish-bones, or from septic infection of the post-pharyngeal lymphatic glands in children. Dyspnoea may be the first symptom, and without a history and a digital examination it may be mistaken for diphtheria (see p. 193). On examining the posterior wall of the pharynx with the finger, a soft swelling can be felt, bulging into the pharyngeal cavity.

*Treatment.* The child should be laid upon its back, with the head thrown well back over the end of the table. The mouth is held open with a gag, and an incision made through the post-pharyngeal wall into the abscess, the knife being guided with the left forefinger (Fig. 12). Mounted swabs should be in readiness to mop up the pus as it escapes. The throat should afterwards be

• syringed frequently with some mild antiseptic fluid, such as 1 in 80 carbolic. •

An alternative operation is that of evacuating the pus through an incision in the neck, just behind the sterno-mastoid. The skin and deep fascia are incised, and the abscess entered with a pair of sinus forceps. The advantage of this route is that there is no risk of septic pneumonia from inhalation; the disadvantages are that it is more difficult, and that there is danger of a spreading deep cellulitis of the neck. We do not recommend this method in the acute cases.

(d) *Palmar abscess.* A deep abscess of the palm can be opened without danger of injury either to tendon sheaths (Fig. 13), nerves, or arteries, if the incision is made over the long axis of the second, third, or fourth metacarpal bone, and extends only from the level of the head of the metacarpal bone to the level of the abducted thumb.

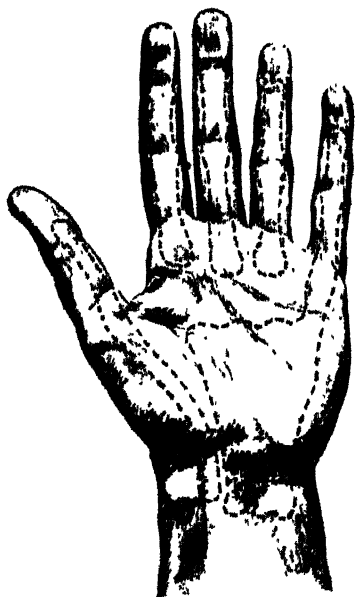


FIG. 13. Arrangement of synovial sheaths.

(e) *Mammary abscess.* Early cases are often amenable to treatment by Bier's cups (see p. 73), in which case the incision may be quite small. In a neglected case free incisions should be made, radiating from the nipple towards the periphery. In an abscess of any considerable size there are usually

a large number of loculi separated from one another by fibrous bands. These require breaking down thoroughly with the finger, which should be freely swept throughout the cavity in all directions.

As these abscesses commonly occur in the lactating and therefore vascular breast, the bleeding is often very free, so that it is necessary to plug the cavity firmly with gauze, which should be replaced by tubes after some twenty-four hours. In the worst cases the whole breast is riddled with loculi of pus rendering proper drainage difficult or impossible, so that troublesome and persistent sinuses form. It is sometimes good treatment to amputate such a breast, as serious constitutional symptoms occasionally

attend prolonged suppuration, whilst the gland could never again be functional and might later become the seat of carcinoma.

(f) *Ischio-rectal abscess.* It should be realized that these abscesses, if allowed to burst spontaneously or imperfectly opened, are a fruitful source of fistula. They should therefore be opened early and freely by one or more incisions radiating from the anus into the ischio-rectal fossa. This disposition of the incisions need not be strictly adhered to, as it is sometimes best to make them in a vertical direction as the patient lies in the lithotomy position. Their length and number must be such as to ensure the absence of pocketing, and this is determined by inserting the finger so as to ascertain the limits of the abscess cavity. The after-treatment consists of a daily hip bath for half an hour or more, followed by careful plugging. This should be given immediately after the morning evacuation of the bowels.

## 2. *Cellulitis*

Diffuse cellulitis, wherever it occurs, requires early and free incision, for the local and constitutional effects in a neglected case may rapidly attain serious proportions. The diagnosis is usually simple, the only conditions at all likely to be confused with it being cutaneous erysipelas and, particularly in the case of the leg, acute periostitis. As regards the former, the main points of difference are that in erysipelas the constitutional symptoms are more severe at the outset, the temperature rising rapidly to 103° or 104° F.; the skin itself rather than the subcutaneous tissue is cedematous and tense; the redness is bright and uniform, often presenting a definite margin, and the smooth shiny surface almost always presents a number of vesicles or blebs of varying size. In a child with a brawny redness over the tibia it is not always easy to say whether the inflammatory exudate is subcutaneous or subperiosteal. In the former case the constitutional symptoms are not usually so severe, the onset is more gradual, and there is generally some recognizable focus of infection.

*Treatment.* Incisions must be made into the infiltrated subcutaneous tissues without waiting for the appearance of pus as a recognizable collection, and the incisions must be of adequate extent. If the area involved is extensive, it is a good plan to make a number of parallel incisions, each two or three inches in length, leaving bridges of undivided skin between them. The bleeding is often very free, so that the wounds may require plugging with gauze strips for the first dressing. After twelve hours

Or so the plugs can be removed and left out altogether. Tubes are rarely of any use unless the cellulitis has invaded the deeper and intermuscular planes; the gaping of the incisions ensures proper drainage. The after-treatment consists in the frequent application of large hot fomentations and appropriate constitutional treatment. If the part involved is a limb, the continuous bath is an excellent form of treatment, relieving pain, ensuring continuous drainage and preventing absorption. In these cases the employment of Bier's hyperæmic treatment is not to be recommended on account of the tendency for the skin to slough.

### *Cellulitis in Special Regions*

(i) *Cellulitis of the tongue.* This may be due to a punctured wound of the tongue by such an object as a fish-bone, or may accompany an ulcerative stomatitis, or be consequent upon necrosis of the mandible. The tongue may become swollen to an enormous size and project from the mouth. Dyspnoea may be urgent, and the constitutional symptoms are of a severe type. The treatment consists in making incisions both into the tongue in its long axis, and also in the middle line below the chin so as to drain the deeper intermuscular planes of the organ. Hot fomentations round the jaw, and frequent spraying of the mouth with an antiseptic mouth-wash, are required afterwards.

(ii) *Orbital cellulitis.* See Chapter XXII.

(iii) *Cellulitis of the neck.* Ludwig's angina is, strictly speaking, an acute diffuse cellulitis, accompanied by great œdema, commencing in the submaxillary region and affecting the tongue and floor of mouth. The disease most commonly follows periostitis arising in connexion with dental disease. The term, however, is often used to include any case of acute diffuse cellulitis of the neck marked by extreme œdema, whether commencing in the submaxillary region or not. In the course of any such case of cellulitis, urgent dyspnoea is apt to come on at any moment, and is not infrequently brought on by the administration of an anæsthetic for the purpose of making incisions. A general anæsthetic is therefore to be avoided; should it be absolutely necessary chloroform is to be preferred.

It is most important to avoid tracheotomy in such cases, because it is almost certain that septic material will be inhaled, causing an 'aspiration pneumonia' which will probably prove fatal.

Free incisions (Fig. 14) must be made into the brawny indurated tissue, and hot lotion dressings, frequently changed, should be

employed afterwards. The laryngeal inflammation may subside rapidly, but the patient should be carefully watched, and if the stridor increases tracheotomy must be performed, despite the risk of septic pneumonia.



Fig. 14. Incisions for submaxillary cellulitis.

(iv) *Pelvic cellulitis.* Most frequent as the result of post-partum infection, it also occurs from urinary extravasation, injuries of the rectum, and infective periostitis of the pelvic bones. The most profound symptoms of septic intoxication and of septicæmia occur in the acute cases, and unless prompt relief is given, a fatal termination is probable.

*Diagnosis.* Severe febrile symptoms not otherwise accounted for in a patient suffering from one of the above-mentioned causes, together with local pain and possibly œdema of the legs, are highly suggestive of pelvic cellulitis. Vaginal or rectal examination may reveal a fixed swelling in the pelvis; abdominal palpation may reveal the presence of a diffuse mass above Poupart's ligament on one or both sides. Such pelvic swellings cannot of course be distinguished by examination alone from intra-peritoneal abscesses in the same situations and of similar origin.

*Treatment.* When a definite mass can be felt it must be incised at the point where it is most accessible, having regard for its anatomical situation. When above Poupart's ligament, an incision is made through the abdominal wall parallel with Poupart's ligament; the peritoneum is pushed aside, and the pus reached by cautious digital exploration. The position of the inguinal canal and deep epigastric artery must be borne in mind so that they may be avoided. When the mass presents itself in the

mid-line above the pubes, as it may do after injury to, or supra-pubic puncture of, the bladder, the incision is made vertically in the mid-line so as to pass between the recti muscles. In certain puerperal cases the pus is reached most conveniently through a vaginal incision. General symptomatic treatment is also called for. The bowels must be kept freely open, and hot fomentations and hot antiseptic vaginal douches will be found to give relief. The question of specific vaccine treatment must also be considered (see p. 59).

### 3. *Acute lymphangitis*

This is readily recognized by the presence of red streaks passing up the limb from some superficial septic focus to the enlarged tender lymphatic glands. There is usually a good deal of œdema in the neighbourhood of these inflamed lymphatic vessels, and indeed the condition readily passes into a diffuse cellulitis. The treatment consists of disinfection of the primary focus; the application of fomentations; and the incision of any glandular abscesses or subcutaneous collections of pus which may appear.

### 4. '*Post-mortem*' wounds

Wounds of the fingers made in the course of a post-mortem examination or a septic operation are a source of great anxiety to medical men. Fortunately the majority are attended by no ill effects, but they may be followed by the most disastrous consequences. The worst cases develop septicæmia in the course of only a few hours; others cause a rapidly-spreading cellulitis; others again lymphangitis, axillary abscess, and whitlow.

Naturally, no one with an abrasion of the skin would knowingly expose himself to the chance of infection, and the use of rubber gloves greatly diminishes the risks of accidental wounds. Directly such a wound has been received, the hands must be thoroughly washed with ether soap and an abundance of hot water, bleeding should be encouraged, and suction should be employed; after which the wound may be treated with a drop or two of pure carbolic acid. The graver complications that may follow are treated of elsewhere (see Septicæmia, p. 57).

### 5. *Thrombo-phlebitis*

This occurs in two distinct clinical forms, infective and non-infective. The latter is dealt with at p. 224. Infective or suppurative thrombo-phlebitis is seen in connexion with septic compound fractures, acute bone disease, carbuncle, puerperal

sepsis, and mastoid disease. The treatment is that of pyæmia (p. 59), in addition to measures such as incision of local septic foci and ligation of the main vein on the cardiac side.

#### 6. *Carbuncle*

This is a form of gangrene due to the action of the pyogenic cocci upon the skin and underlying structures in situations where the tissues are dense and the blood-supply poor. Diabetes or renal disease may be contributing factors, so that the urine should always be examined in these cases. But the glycosuria which is not infrequently present may be only symptomatic and transitory. A carbuncle is attended with much pain, and often with a degree of constitutional disturbance apparently out of proportion to the size of the lesion. It must never be regarded as a trivial matter, for pyæmia and septicæmia occasionally occur even in the apparently healthy and from quite a small carbuncle. In the obese, alcoholic, and diabetic the dangers are greatly increased.

*Treatment.* In the early stages there is no treatment which gives better results than Bier's suction hyperæmia (see p. 75). The good effect of this cupping is increased by making a number of small punctures into the inflamed tissues with a sharp-pointed tenotome. At the same time an inoculation may be given of a stock vaccine of staphylococcus aureus pending the preparation of an autogenous vaccine.

In an advanced case free incisions are necessary, followed by hot fomentations, and in these cases also vaccine treatment gives good results. The slough must be allowed to separate naturally, and on no account is the curette to be used.

#### 7. *Gangrene*

A well-marked case of dry senile gangrene can scarcely be called an emergency, but in its early stage the course of the disease depends very much upon the prompt adoption of the correct line of treatment. All forms of moist gangrene, and especially those due to specific micro-organisms, constitute very pressing emergencies. The various forms will be briefly considered.

(i) *Senile gangrene.* Following exposure to cold, or some injury or trivial infection calling for a supply of blood which the diseased arteries are unable to supply, senile gangrene is commonly of the dry variety, causing little constitutional disturbance beyond that occasioned by pain, sleeplessness, and anxiety. The question of operative treatment must be discussed, but it need only be said here that if amputation is decided upon, it is useless to operate

anywhere below the knee, because the gangrene is sure to return in the stump. The operation of choice is a circular amputation immediately above the femoral condyles. We are more concerned with the immediate treatment of threatened gangrene when the toes are cold, reddish blue, and mottled. At this stage, gangrene may be averted, or at least its extent curtailed by appropriate treatment. The patient must be put to bed, and the foot kept warm by being enveloped in dry cotton-wool, after being well covered with dry boracic powder. In fact, *warmth* and *dryness* are the two essentials. Stimulants and a good nourishing diet are to be recommended, and pain and sleeplessness are to be met with opium.

(ii) *Embolic gangrene* is of sudden onset accompanied by pain and soon followed by numbness, pallor, and coldness in the affected limb, most commonly the leg. Some cardiac affection is usually present and is the source of the embolus. The subsequent course is that of a moist or a dry gangrene, commencing in the toes and rapidly spreading up the leg. If moist, as is usually the case, the patient suffers from the toxæmia of septic absorption, and glycosuria may appear; in these cases amputation close to the site of the embolus is usually to be recommended at once, without waiting for a line of demarcation. If the gangrene is dry it is sometimes advisable to wait for the appearance of a line of demarcation, and then to amputate through healthy tissue above it. In all these cases, however, the patient's general condition must be made the deciding factor.

(iii) *Thrombotic gangrene* from arterial thrombosis in the acute fevers (typhoid, measles, pneumonia) is of a similar character, and is to be treated on the same lines.

(iv) *Diabetic gangrene*. This usually takes the form of a rapidly advancing moist gangrene with profound toxæmia, and the prognosis is extremely grave. Early amputation through healthy tissue well above the advancing gangrene offers almost the only prospect of recovery. These cases are peculiarly suitable for spinal anaesthesia, as the administration of a general anaesthetic is prone to determine the onset of diabetic coma.

(v) *Frost-bite*. Occasionally dry when affecting the nose, fingers, and ears, frost-bite of the foot more frequently assumes the form of a somewhat rapidly advancing moist gangrene. In the early stage the affected part is swollen, cold, bluish-red, and although numb is nevertheless very painful. A too vigorous application of warmth at this stage may determine the onset of gangrene, which might otherwise be prevented. When actual moist gangrene is present, it is necessary to ampu-



tate at once ; but in slighter cases the parts may be kept dry and warm, and amputation resorted to only after the limit of the gangrene can be seen from the appearance of a line of demarcation. The advantage of thus waiting is that the amputation need not be done so high up as it otherwise would have to be.

(vi) *Acute spreading traumatic gangrene.* See p. 80.

#### 8. *Suppurative Tenosynovitis.*

Suppuration in a tendon sheath derives its chief importance from the liability to sloughing of the contained tendon, and from the possibility of invasion of the adjacent joint. Prompt action will often prevent these complications.

The pus of a *whitlow* may be situated either in the subcutaneous tissue, beneath the periosteum, or within the tendon sheath. The first two require no special description, except to point out that the tendon sheaths of the fingers terminate at the bases of the last phalanges and that incisions over the terminal

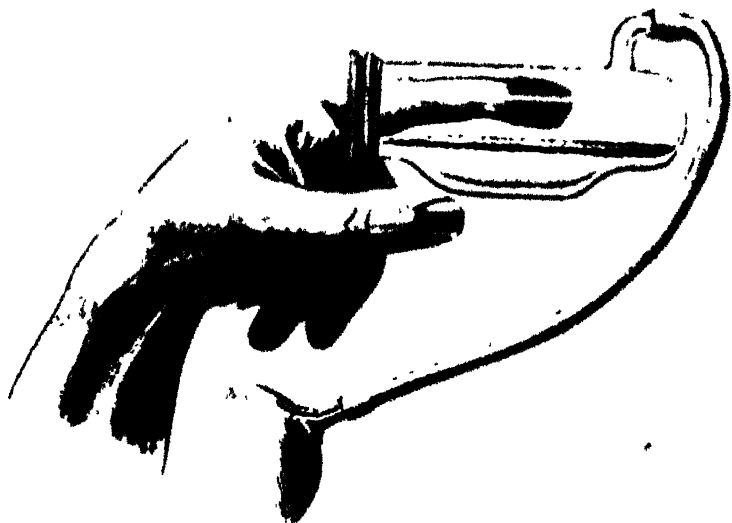


FIG. 15. - Bier's treatment applied to a whitlow.

phalanges may be made boldly down to the bone without fear of wounding them."

It is not always easy to decide whether the pus of a whitlow which involves more than the terminal phalanx is within the synovial sheath or outside it. This is especially the case when the perithecal inflammation is accompanied by an effusion of serous fluid into the tendon sheath. If such a thecal swelling is due to

pus, immediate incision offers the only prospect of saving the tendon; if not, then an incision through infected tissues is almost certain to infect the synovial membrane. In any such case of doubt it is best to incise down to, but not into, the sheath, and, applying hot fomentations, to watch carefully the course of events during the next twelve hours or so. If no improvement has occurred by that time, the probability is that there is pus within the sheath, which must then be opened and drained. The usual arrangement of the tendon sheaths of the hand is shown in Fig. 13.

*After-treatment.* The hand should be immersed in a boracic bath for several hours a day, and hot fomentations applied in the intervals. The patient should be encouraged to begin moving the fingers at once, in order to prevent stiffness as far as possible. As recovery proceeds the movements, both active and passive, should become more frequent and more extensive. If healing is delayed, and the movements are greatly impaired, the probability is that the tendon has sloughed and will require removal.

Bier's treatment (p. 73) can often be employed for these cases (Fig. 15) and is often followed by the most gratifying results.

#### 9. *Acute bone disease*

Acute infective disease of bone is one of the most urgent of local suppurative affections. Unless subjected to early and free incision, the consequences may be disastrous, both locally and constitutionally; the rapid spread of the disease involves extensive necrosis of bone and destruction of neighbouring joints, whilst pyæmia and septicæmia are very likely to supervene. The disease manifests itself in various ways, and is consequently known by a variety of names, such as acute infective periostitis, epiphysitis, and osteomyelitis, according to the part of a bone first affected; more generally it is spoken of as acute necrosis.

*Diagnosis.* The disease commonly occurs in children and more particularly in unhealthy children. It is perhaps most often seen as a sequela of measles and scarlet fever.

When it takes the form of an acute epiphysitis it may be mistaken for acute rheumatism (see p. 161) on account of the concomitant effusion into the neighbouring joint. When the shaft of a superficial bone like the tibia, which is one of the commonest sites, is affected the disease may be mistaken for cellulitis or erysipelas. In cellulitis there is usually some septic focus from which the spreading inflammation has originated; the redness and œdema are less regularly distributed; the tenderness

is not so acute; red streaks indicating lymphangitis, and enlarged superficial lymphatic glands may be felt, and the patient does not become so rapidly and acutely ill. Still, it is sometimes very difficult to arrive at a diagnosis, and then exploratory incision must be undertaken. Erysipelas should be readily distinguished by its peculiar local appearances (p. 76). At times acute necrosis affects isolated patches of bone, deeply situated, so that the diagnosis may be a matter of difficulty. Thus we have seen the ischial spine affected, giving rise to a small deeply situated abscess with little to guide the diagnosis except indefinite swelling of the buttock, with pain and severe constitutional symptoms. The skull and vertebrae are also occasional seats of the disease.

An uncommon condition which may be difficult to distinguish from acute necrosis is the subperiosteal hæmorrhage which occurs in children with scurvy rickets. The onset is abrupt, with pain and fever, the swelling over the bone is similar, and an epiphysis may be separated from the shaft. The range of temperature, however, is not so high in these cases; redness of the skin is slight or absent; and other evidences of scurvy rickets, such as subcutaneous hæmorrhages and a history of other spontaneous hæmorrhages may be present to indicate the diagnosis.

*Treatment.* There should be no hesitation in operating at the earliest possible moment, so as to provide free and efficient drainage. The incision should be placed over the region of greatest swelling, and, in the case of a superficial bone, should pass at once down to the bone. In other situations, as for example the dorsum ilii, it is necessary to plan the incision so as to divide the intervening muscles in the direction of their fibres, and to avoid nerves and important vessels. The size of the incision should always be large enough to provide ample drainage and to avoid pocketing. When the bone is deeply placed, large drainage tubes must be used, but for a superficial bone like the tibia, there is no need to employ tubes at all; the incision, which gapes widely, should be packed with strips of gauze. A culture from the pus should always be taken at the time of operation, because, should pyæmic complications occur, a knowledge of the bacteriology might be of the greatest use.

When the diseased bone is situated in the near neighbourhood of a joint, and the joint itself is not involved, great care must be taken that the incision does not open into the synovial cavity.

The question often arises as to whether it is necessary to open

into the medullary cavity of the shaft of a long bone affected with acute necrosis. It is not always an easy question to answer, because if the affection were primarily a periostitis, and the case were seen early, the whole thickness of the bone might not be involved and opening the medulla might set up an infective osteomyelitis. On the other hand it often happens that the whole thickness of the bone is already dead, in which case gouging into it would do no good. In case of doubt it is generally best to leave the medulla alone, but, if the constitutional symptoms do not rapidly abate, and there is nothing else to account for the continuance of the symptoms, the medullary cavity should be opened at a second operation.

*After-treatment.* Locally, frequent syringing, or, if the site of the lesion renders it possible, continuous bath treatment, is indicated. Spreading of the infective process and residual abscesses must be carefully watched for and dealt with promptly should they occur. At the same time every effort must be directed to maintain the patient's strength. In bad cases, the nature of the organisms having been ascertained from the cultures taken at the first operation, serum treatment may be tried. When, in spite of everything, no improvement in the general condition is obtained, and especially if rigors or other symptoms indicating the onset of pyæmia occur, amputation must be resorted to.

#### BIER'S TREATMENT FOR ACUTE SEPTIC DISEASES

The excellent results which have been obtained in many acute septic conditions render it advisable for all who may have to treat such conditions to make themselves acquainted with this method of treatment. It would be out of place to discuss the pathological grounds upon which the treatment is based. Briefly it may be stated that inflammatory hyperæmia indicates nature's method of dealing with a tissue infection by determining a largely increased supply of blood to the part. Bier's treatment seeks to imitate this by producing an artificial hyperæmia, either by the application of an elastic bandage on the cardiac side of the diseased area, or else by means of various forms of suction apparatus.

(a) *The elastic bandage.* This means of inducing hyperæmia is applicable to the limbs, and also, in a modified form, to the head and neck. An ordinary rubber bandage is applied to the limb proximal to, and well clear of, the area which needs treatment. It must be tight enough to cause obstruction to the veins, whilst not interfering in any way with the arterial supply.

A little practice will enable this to be done accurately, provided that the following points are kept in mind?

(i) The pulse beyond the bandage must always be easily perceptible.

(ii) The limb, when the hyperæmia is fully established, must appear bluish-red, and not white or deeply cyanosed.

(iii) No pain must be caused, neither must any pain already present be made worse. In fact, one of the gratifying results of the treatment is the relief of pain which it affords.

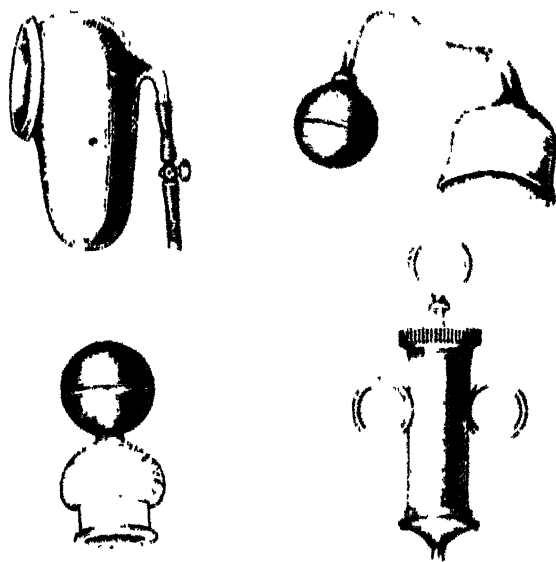


FIG. 16. Cups and pump for Bier's treatment.

No hard and fast rules need be laid down as to the length of time that the bandage is to be allowed to remain on. In such conditions as acute cellulitis of a limb, Bier recommends that it should be from ten to as long, in certain cases, as twenty-two hours daily at first, and then gradually less and less as the condition improves. It is essential that the interval between the applications of the bandage should be long enough to allow the artificially produced œdema to subside completely.

It is important that the dressings should be removed, or at least loosened, whilst the bandage is in place, to permit the parts to swell.

(b) *Suction apparatus.* A large variety of shapes and sizes of glass cups can be obtained (Fig. 16). They may either be applied

to the skin so as to include the diseased area (Fig. 17), or a whole limb may be encased in a glass cylinder made air-tight by a rubber sleeve (Fig. 18). The proper degree of exhaustion of the



FIG. 17.—Bier's cup applied to a carbuncle.

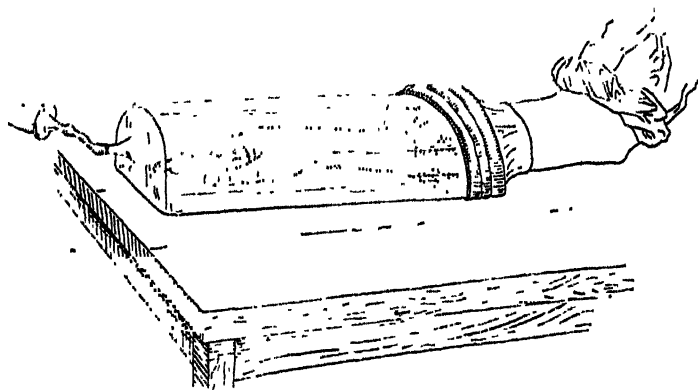


FIG. 18. Bier's treatment applied to the hand.

cup or chamber is obtained either by an attached rubber ball in the smaller ones, or by an aspirating pump in the larger.

The points to be attended to in using this method are similar to those pointed out for the elastic bandage method, namely that no pain must be caused, and that the skin within the area under

treatment should never be allowed to appear white, but of a bluish colour. In this method not only is hyperemia produced, but drainage is assisted by means of mechanical suction.

It must not, however, be thought that the necessity for incision to evacuate pus is done away with, though it is claimed that the incisions need not be so large as those necessary in the more usual methods of treatment. Bier recommends that the cup should be applied for five minutes six times a day.

### III. SPECIFIC INFECTIONS

#### 1. Erysipelas

On account of its contagiousness, it is of great importance that the disease should be promptly recognized and the patient isolated, especially in hospital practice. Erysipelas is a specific disease affecting both skin and mucous membranes, and requiring some abrasion or wound as a point of entry for its streptococcus. The great majority of cases affect the face and scalp, and it is not always possible to trace the point of inoculation.

The *diagnosis* is usually easy. The onset is abrupt, with a sudden rise of temperature to 102° F. or higher, and often with a rigor. The constitutional symptoms are severe, and delirium may be present. Locally the disease is recognized by a tense, swollen, bright red, shiny appearance of the skin, usually with vesicles, and sometimes with a definite spreading edge. Too much importance must not be attached to the spreading edge, for although when present it is quite characteristic, it is absent in a large number of cases. The disease is always most marked at the periphery of the affected area, the parts first affected becoming pale as the rash spreads at the periphery. The face, eyelids, and lips, may be enormously swollen. The affections which are likely to be mistaken for erysipelas are diffuse cellulitis, acute periostitis of a superficial bone, erythema nodosum, and severe insect stings. In the last two, the constitutional symptoms of erysipelas are absent. In acute periostitis, the skin has not the bright redness of erysipelas, nor are there vesicles upon its surface; no point of inoculation is found, and the glandular enlargement usually seen in erysipelas is absent.

*Course.* An ordinary attack lasts from a week to a fortnight, and the symptoms abate somewhat suddenly, some cases showing an abrupt termination of the fever by crisis. The mortality is not greater than 5 per cent, and such cases as die are to be found amongst the very young, the aged, and the alcoholic.

When the lips and mouth are affected there is a considerable risk of extension to the pharynx and of oedema of the larynx (see p. 192).

*Treatment.* Any local wound or septic focus should be thoroughly cleansed. At the outset a brisk purge should be given. If there is much insomnia or delirium, chloral and bromide should be tried, and if these fail, opium. Stimulants may be necessary.

Locally, the application of hot fomentations gives relief, but when the face is affected it is sufficient to dust the skin with starch powder and to cover it with a layer of cotton-wool.

*Vaccine treatment.* Good results are being obtained from the use of a vaccine prepared from the streptococcus pyogenes. It is better if an autogenous vaccine can be used from the organism cultivated from one of the vesicles. An initial dose of five million cocci should be injected at a distance from the site of the disease. If the attack is a mild one a larger dose, ten or even twenty million, may be used. If necessary a further injection may be made on the third day and again on the fifth.

We have also seen good results follow the use of a multivalent antistreptococcus serum. The patients have felt much better, have slept better, and the fever has diminished almost immediately after the injection, though little effect seems to have been produced on the rash or on the duration of the disease.

## 2. TETANUS

In this disease so much depends upon the promptness of the treatment that its early recognition is a matter of the utmost importance. The *diagnosis* presents no difficulty in the presence of a dirty wound received a few days before the onset of the symptoms. But sometimes no point of infection can be discovered, and the symptoms may be atypical, in which case the diagnosis is sometimes very difficult. The chief feature of tetanus is the occurrence, at intervals varying with the severity of the case, of muscular spasms, tonic in character, and with incomplete relaxation of the muscles between the spasms. The muscles are affected in a definite order, first those of the jaws and neck, then the back and trunk, and finally the limbs. The pain is very severe, the pulse rapid, and the temperature usually not raised. Retention of urine, constipation, and inability to swallow are common. The least external stimulus may bring on a convulsion. The two conditions most likely to be mistaken



for tetanus are *trismus*, from the irritation of a carious or unerupted tooth, and *stiff neck* of a rheumatic nature. In both a definite cause can be recognized from examination and history, and in neither do spasms occur. *Strychnine poisoning* is differentiated by the history, the early involvement of the limbs, and by the fact that the muscles are completely flaccid between the spasms, whilst in tetanus they are never completely relaxed.

*Treatment.* The focus of infection must be removed without delay. If situated upon a finger, or upon the foot, amputation is best; in other positions free excision, followed by thorough disinfection of the raw surface with strong carbolic acid, and the application of a gauze dressing kept constantly wet with peroxide of hydrogen. For the operation an anæsthetic is required, and whilst the patient is still under its influence the bladder should be relieved if retention is present, and food and drugs may be administered by a stomach tube. At the same time a dose of antitetanic serum should be given. Not less than 25 c.c. should be given at a time, and larger doses may usually be given with advantage. The mode of its administration does not seem to affect the results in any marked manner, and perhaps the subcutaneous method is as good as any. It has not been shown that there are any advantages attending the cumbersome method of injecting the serum into the brain substance through a trephine hole, but it is possible that the intraspinal method is superior to others, as some of the published cases seem to show. If used in this manner, the antitoxin is injected into the spinal theca in exactly the same way as the novocaine solution is injected in spinal anaesthesia (see p. 8). 20 c.c. at a time can safely be used and some cerebro-spinal fluid should be allowed to escape before making the injection. The dose should be repeated every four hours until about 100 c.c. have been given.

Recently the intradural (spinal) injection of a sterilized 25 per cent aqueous solution of magnesium sulphate, in doses of from 2 to 4 c.c. repeated at intervals of twenty-four hours, has been advocated. This treatment appears to control the spasms and relax the muscles very effectively. We know, however, of one case in which paraplegia developed soon after the injection, and proved fatal.

The injection of novocaine into the theca, as in producing spinal anaesthesia, has been suggested as a means of controlling the spasms, and might be given a trial.

*After-treatment.* The patient must be put to bed in a quiet

and darkened room. Large doses of chloral and potassium bromide, 20 to 30 grains of each, should be given every four hours, and if that fails to control the spasms chloroform should be continuously administered. Morphia is useful in some cases. If retention of urine is present, the bladder must be emptied by catheter at regular intervals, and food may have to be administered by the stomach tube. As both these manipulations are apt to produce convulsions, they are best carried out under chloroform anaesthesia.

### 3. ANTHRAX

As met with in man in this country, the point of inoculation is generally situated upon the hands or face, and takes the form of a red irritable papule, which soon becomes vesiculated, and rapidly attains the form of a central black slough surrounded by a ring of vesicles. There is always some oedema around, which in bad cases is very marked and spreads quickly. At the same time there are symptoms of severe constitutional disturbance, and, unless the case is treated promptly, fatal septicaemia supervenes.

The *diagnosis* is readily made by stained film preparations of the fluid from the vesicles. Two conditions may give rise to errors of diagnosis: (a) sometimes the anthrax pustule is closely simulated by a staphylococcic infection, from which the diagnosis can only be made with certainty by a bacteriological examination, and (b) an accidental vaccination pustule may possibly be mistaken for anthrax. The history of the case should prevent this error.

*Treatment.* If the focus of infection is upon the hand or neck, it should be freely excised, and the raw surface painted with pure carbolic acid. Upon the face, and especially upon the eyelid, such treatment would be followed by severe deformity, so that the alternative treatment of carbolic injections may be adopted. This consists in injecting into and around the 'pustule' from 12 to 15 minims of pure carbolic acid at different points. The injection may be repeated if necessary. Treatment by the application of caustic potash and other strong chemicals has been tried with success. •

By the use of Selavo's serum the mortality has been reduced from about 30 per cent to about 5 per cent, or even lower. This serum can now be obtained commercially, and should be injected subcutaneously in doses of from 30 to 40 c.c.

#### 4. EMPHYSEMATOUS GANGRENE

This disease, formerly known as 'acute spreading traumatic gangrene', is in the great majority of cases in man due to the *Bacillus aerogenes capsulatus*. It may be simulated by the formation of gaseous products of decomposition in tissues gangrenous from other causes, and these require careful differentiation.

The disease is apt to occur in cases of extensive lacerated wound, and in compound fractures, especially if accompanied by much bruising, and particularly where road dirt has been ground into the wound. In from twenty-four to forty-eight hours the temperature rises to 103° or 104° F., symptoms of profound toxæmia become evident, and the infected tissues become oedematous and discoloured, whilst gas crepitation can be felt in and beyond the oedematous area. The wound pours forth a turbid, straw-coloured fluid with a peculiar musty odour, often in great abundance, and from this fluid stained film preparations will show the presence of the characteristic bacillus.

*Treatment.* In spite of much that has been said, it is not always necessary to perform amputation at a great distance from the focus of infection; in fact the situation sometimes renders such treatment out of the question, as, for example, in a case affecting the chest-wall. However, when amputation is possible it is certainly safest to adopt that line of treatment. It should be done above the area of discoloration but not necessarily above the area of oedema. No stitches should be put into the flaps, but the wound should be left widely open and packed with gauze soaked, and afterwards kept constantly wetted, with hydrogen peroxide. This solution is recommended because the oxygen which is given off on contact with the tissues is inimical, if not fatal, to the anaerobic *B. aerogenes capsulatus*. If by this means the disease has been arrested, the flaps may, after a few days, be adjusted by a few sutures. When amputation is not possible, numerous large incisions should be made into the oedematous tissues, which should then be energetically treated with peroxide of hydrogen. Symptomatic constitutional treatment is required at the same time.

#### 5. CANCRUM ORIS

This is a peculiar and perhaps specific form of gangrene which sometimes attacks unhealthy children, especially when convalescent from measles or other specific fever. It is to be recognized

by the appearance upon the cheek or lip of a central dark area of necrosis surrounded by a wide area of brawny œdema, accompanied by constitutional symptoms of an extremely severe character. Unless energetically treated, the gangrene very rapidly extends, and in two or three days the patient dies from acute toxæmia.

It may, in the earlier stages, be mistaken for gangrenous stomatitis, but in this disease the interior of the mouth is extensively ulcerated, the œdema comparatively slight, and the constitutional symptoms are of a less severe type. Unless a careful examination, with a good light, is made of the interior of the mouth, the earlier stages of cancrum oris may escape diagnosis, and valuable time may be lost.

*Treatment.* The patient must be anæsthetized, and the gangrenous area freely cut away with scissors. The limit of the excision is indicated when the tissues beyond the area of stasis are reached, as will be shown by the capillary hæmorrhage that occurs. The whole surface of the wound is then to be painted over with pure carbolic or strong nitric acid, and hot fomentations frequently applied. Afterwards, the mouth and wound should be frequently syringed with some such antiseptic as formalin (1 in 2,000) or 'Listerine'. At the same time the patient's strength is to be supported by good food and stimulants.

If recovery takes place, a plastic operation will probably become necessary.

## 6. PIAGEDENA

This form of gangrenous ulceration which sometimes occurs upon the genitals may perhaps be caused by a specific infection, and may or may not be complicated by syphilis. Energetic treatment is required. If the prepuce is long or tight, it should be slit up, and strong nitric acid should be applied to the diseased area. The patient should be made to sit for several hours a day in a boracic bath, and in the intervals wet dressings of chlorinated soda should be frequently applied. If complicated by syphilis, antiluetic treatment should be vigorously employed in addition. From time to time sloughs may require removal, and when healing has taken place, some plastic operation may be called for.

## IV. THE INFECTIOUS FEVERS

Accurate and prompt diagnosis of an acute infectious disease is a matter of considerable urgency, owing to the risk of spread of infection if proper precautions are not taken. This applies particularly to cases occurring in schools, hospitals and institutions. In some cases, such as German measles and chicken pox, the diagnosis practically constitutes the emergency: for once made, the case is isolated, little in the way of treatment may be required and the practitioner's efforts should be directed in the main to the isolation of contact cases and to the prevention of an epidemic.

Enteric fever, scarlet fever, measles, German measles, diphtheria, mumps, chicken pox, and small-pox give rise perhaps to the greatest difficulty. The diagnosis of these diseases will be first considered, then the general management of a case of infectious fever, with methods of disinfection, then the treatment of some of the more important fevers, and lastly the question of school attendance.

## 1. ENTERIC FEVER.

The disease usually commences insidiously and it is often impossible to assign the exact date of its onset. There is marked lassitude and loss of appetite, headache is common and the patient feels generally unwell. Epistaxis may usher in an attack, bronchitis is sometimes a prominent feature and abdominal pain may be an early symptom. The date on which patients take to bed is therefore very variable; some people resort to bed on slight provocation, whilst others fight against the often indefinite symptoms of commencing enteric fever for as long as possible, and the disease may be well advanced before a medical man is consulted; such cases are termed 'ambulatory'; they are usually severe and not infrequently end fatally. In rarer cases enteric fever begins abruptly with chills. For these reasons a case may come under observation either very early when diagnosis is often very difficult, or at a later stage when high fever and some of the classical signs are present.

The temperature rises gradually during the first week and then persists with slight daily remissions during the second week or longer. The pulse is increased in rate but not in proportion to the rise of temperature; it is often markedly dicrotic.

Severe and persistent headache is a valuable sign; sometimes it is associated with retraction of the head and the case may closely simulate meningitis.

• The facial appearance is often suggestive ; at first the cheeks are flushed and the eyes bright, but towards the end of the first week the expression becomes dull and lethargic and the patient tends to 'sink into the bed'.

The tongue is at first coated with white fur but later becomes dry ; it is sometimes covered with dark brown fur or with crusts, and the teeth and lips with sordes.

The rash appears at the end of the first week or at the beginning of the second. It consists of slightly raised rose-red papules which disappear on pressure ; these usually appear first on the abdomen and as a rule are not very numerous. Each spot lasts for two or three days, and they come out in successive crops. They may also appear on the thorax, back and limbs. Sometimes the rash is very copious. It is important to note that one or two spots alone are almost valueless from the diagnostic standpoint, as it is common to find a spot indistinguishable from those found in enteric fever in any patient, and particularly in those with a 'spotty' skin.

The spleen is usually enlarged, but the diagnosis cannot rest on this as enlargement occurs in many other febrile affections. The spleen may only just be felt below the costal margin or it may descend for a couple of inches on inspiration. It is noticeably soft. Leucocytosis is absent and in fact the number of white cells is diminished.

The presence of stools resembling pea soup has been considered of importance, but the sign is of only small value and its absence by no means excludes enteric fever inasmuch as constipation is more common than diarrhoea.

The above comprise most of the signs and symptoms which are helpful in the earlier stages of an attack. Reliance is to be placed not on a single sign, but on the general weight of the evidence after a careful consideration of all the factors.

Fortunately certain special methods are available which are of the greatest value, especially in doubtful cases. These are the Widal reaction and the isolation of the typhoid bacillus.

(a) *The Widal Reaction.* The blood-serum of a patient suffering from enteric fever possesses the power of agglutinating or clumping typhoid bacilli. The finger or ear should be cleansed, then pricked, and a good sized drop of blood allowed to run into a small glass pipette. After sealing the ends of the pipette in a flame it should be sent to a clinical laboratory for investigation. The serum which separates from the clot in the pipette is diluted with normal saline and mixed with a recent culture

of typhoid bacilli. Clumping should occur with a dilution of 1 in 50 and should be complete within one hour for the result to be considered positive. Certain fallacies have to be guarded against. It is rare for the test to be positive during the first week of the disease; it is sometimes very late in its appearance; occasionally it is positive in the absence of enteric fever; and finally it is absent in cases of paratyphoid fever though the clinical appearance of the latter disease may be identical with ordinary typhoid. This last fallacy may be guarded against by testing the serum with the two varieties of paratyphoid bacillus.

(b) *Isolation of the typhoid bacillus.* The blood of a patient suffering from typhoid fever contains the bacillus in the early stages of the disease though it disappears later. A blood-culture may therefore yield positive evidence before the Widal reaction is obtained. The technique of obtaining blood for culture is described on p. 58. Cultures taken from the stools and urine are also of diagnostic value.

## 2. SCARLET FEVER

(a) *Before the rash appears.* The onset is sudden, often with vomiting, or in young children with vomiting and convulsions. The temperature rises to 103° or 104° F., and the pulse rate is disproportionately rapid. Sore throat is complained of on the first day. The fauces and uvula are deeply injected and usually oedematous; the tonsils may be covered with a thin yellowish or white film, and there may be muco-purulent secretion about the fauces, or strings of mucus between the tongue and the palate. The tongue is coated with white fur and the filiform papillae frequently protrude through the fur as red points. Circumoral pallor, whilst the rest of the face is flushed, is an early and valuable sign.

*Diagnosis.* In *tonsillitis* constitutional symptoms are usually not so marked, but they may be very severe. In the follicular form the tonsils show numerous small white patches due to the accumulation of exudation in the crypts. Some forms of tonsillitis do not present the follicular type, and there may be swelling and exudation very difficult of diagnosis from scarlet fever; such are found in the so-called septic throat. Repeated vomiting is suggestive of scarlet fever. The diagnosis sometimes has to be postponed for confirmation by the subsequent course.

In *diphtheria* a definite thick membrane is nearly always present, which tends to spread on to the uvula and soft palate. In severe scarlet fever of septic type the faucial inflammation may be very severe, but there is ulceration rather than membrane formation.

(b) *The rash.* The rash of scarlet fever appears towards the end of the first twenty-four hours or on the second day. It first appears on the neck and chest and then rapidly spreads over the trunk and limbs. It consists of minute bright red spots often coinciding with the hair follicles, and merging into a general erythema. The face, though flushed, is free from the spots. The rash may be somewhat patchy, especially on the limbs. Swelling of the skin is present, especially of the fingers.

*Diagnosis.* It has to be distinguished firstly from the rashes of the other exanthemata. (See Measles, p. 86, and German Measles, p. 87.)

In *Influenza*, an erythematous rash occasionally occurs, and if tonsillitis is also present may give rise to the greatest difficulty. The onset with pains in back and limbs, and the more fleeting character of the rash, are points in favour of influenza, and desquamation is usually absent.

*Septic rashes.* Scarlatiniform rashes are occasionally seen in septic processes, though a morbilliform rash is common, but when there is no coexistent sore throat difficulty should not arise. In tonsillitis, however, an erythematous rash occasionally occurs, but it is usually very fugitive. Tonsillitis should always be regarded as infectious and the occurrence of a rash of course accentuates the need for isolation. It is possible, moreover, that the infection producing such an attack in one person might give rise to genuine scarlet fever in another. Septic rashes are often blotchy in character. It is wise to regard a scarlatiniform rash in a patient suffering from a burn or other septic wound as genuine scarlet fever ('Surgical scarlet fever').

*Enema rash.* An enema of ordinary hard yellow soap sometimes gives rise to an erythematous rash closely resembling that of scarlet fever, but there is no tonsillitis and no fever.

*Drug rashes.* Various drugs such as belladonna, quinine, chloral, and salicylate of soda, may give rise to erythematous rashes. It should be a universal rule in the case of any unexplained rash to ascertain whether any drugs have been taken. There is an absence of fever and tonsillitis, and the rash is often very evanescent.

(c) *Desquamation.* Though peeling is a valuable indication of scarlet fever it should be remembered that it is but one symptom of many and that the diagnosis cannot rest on it alone. Firstly, in some mild cases of scarlet fever it does not occur, and secondly, it not infrequently occurs after measles and German measles. Its presence in a case seen for the first time is very suggestive, and, with a history of sore throat, a 'strawberry' tongue, nasal



discharge, or other common feature of scarlet fever, it is practically conclusive. Another point that may be very helpful in a doubtful case is that after the rash of scarlet fever has disappeared, fine red papules on the outer surface of the legs are often visible and palpable for many days.

### 3. MEASLES

The onset is usually gradual, though headache and vomiting may occur. The common symptoms are running from the eyes with redness of conjunctivæ and eyelids, nasal discharge, sneezing and coughing. Slight soreness of throat is common. Koplik's spots are present on the buccal mucous membrane at about the middle of the cheeks and on the inner side of the lower lips near the angles of the mouth. These are bluish white specks surrounded by a red areola; they usually come out on the first or second day and increase in numbers until the rash appears, when they rapidly vanish. In addition red spots may be present on the palate. Sometimes severe laryngitis is an initial symptom. Bronchitis is common and may become severe or develop into broncho-pneumonia. The temperature rises rapidly to 102° or 103° F., and then may fall on the second day to rise again with the appearance of the rash. The cervical glands are slightly enlarged and the occipital glands may also be involved as in German measles.

*The rash.* This appears on the fourth day. It is composed of reddish macules which speedily become definitely raised above the surface; they are very variable in size and tend to blend together, forming large patches with irregular or curved outlines, whilst the intervening parts of the skin retain their ordinary pale appearance. The resulting appearance is therefore more blotchy than the rash of scarlet fever. The rash fades on pressure, though the finger can often still feel the spots. Petechiæ may occur.

The rash appears first on the forehead and behind the ears and then spreads over the face, neck, arms, trunk and legs. The skin is swollen and the face is noticeably puffy. The circum-oral region is nearly always involved in the eruption. As the rash fades a yellowish stain is left behind and fine branny desquamation is usually to be detected.

*Diagnosis.* In children, sneezing, watering of the eyes, with redness of lids and a cough of laryngeal type are very suggestive of measles. In such cases the mouth should always be examined for Koplik's spots, which appear two or three days before the development of the rash.

The diagnosis from *German measles* is considered below. Measles has been mistaken for *small-pox*, the rash affecting the forehead in both, but in small-pox the onset is much more severe, headache is intense, pains in the back and limbs are very severe, and there is no initial coryza and conjunctivitis.

Measles has also been mistaken for *scarlet fever*. This is due to the fact that occasionally a prodromal scarlatiniform rash appears on the first day. The inflamed throat makes the simulation of scarlet fever still more close. The coryzal symptoms are important and, above all, the existence of Koplik's spots.

#### 4. GERMAN MEASLES (RUBELLA)

*Onset.* In many cases the rash is the first sign to attract attention, but sometimes the child is ill for a day or two, or even for three or four days before the rash appears, and presents initial symptoms somewhat similar to those of ordinary measles, namely headache, sore throat, slight fever and coryza. The mastoid, occipital, and posterior cervical glands are slightly swollen and tender. Fever is slight.

*Rash.* This is composed of numbers of small, pink, slightly-raised spots which are smaller and rather brighter than those of ordinary measles, and do not tend to blend together into patches to the same extent. It appears first on the face, and then spreads to the trunk, arms and legs. Macular spots are nearly always present on the palate and fauces. Sometimes the rash is scarlatiniform in type.

*Diagnosis.* (a) *From ordinary measles.* Difficulty arises firstly from the fact that rubella may show fairly severe initial symptoms lasting for a few days, and, secondly, that in ordinary measles the occipital and posterior cervical glands are not infrequently enlarged. In such a case the diagnosis would rest on the difference in appearance of the rash, on the absence of Koplik's spots, and on the comparative mildness of the average case.

(b) *From scarlet fever.* Mistakes in diagnosis are not uncommon. The rash of rubella rapidly fades from the face, and on the second day the rash on the trunk may have lost its macular character and appear as a diffuse erythema, frequently punctate. The legs, however, commonly show the characteristic spots, and the throat, though sore, usually shows little or nothing in the way of objective signs.

## 5. DIPHTHERIA

Prompt recognition of this disease is a matter of the greatest urgency. With early treatment by antitoxic serum the prognosis is most favourable; with delay, the risk to life itself and the possibilities of grave complications and sequelæ become very serious.

*Onset.* It is of the greatest importance to remember that diphtheria is often very insidious in its onset. The very slightest suggestion of a sore throat, and especially of any glandular enlargement in the neck, demands an immediate examination of the throat. In fact, the throat of an ailing child should always be promptly and repeatedly inspected; otherwise diphtheria will occasionally be overlooked. Initial vomiting is an uncommon symptom in diphtheria.

*(a) Faucial form*

In the early stage a white or yellow film is seen in one or more spots on the tonsils. These coalesce to form a larger membrane, which becomes thicker and opaque; sometimes a thick tough plate is formed. The membrane is often more extensive on one side, and not infrequently spreads on to the uvula and soft palate; it is firmly adherent and when removed leaves a bleeding surface; exceptionally the membrane is friable. The glands in the neck are swollen.

Pain is not severe in diphtheria. In a case of moderate severity, constitutional symptoms are not very severe; headache is not prominent and fever is moderate.

*Diagnosis.* In any case presenting the slightest suspicion of diphtheria a swab from the throat should be sent to a pathological laboratory for bacteriological examination.

1. *From follicular tonsillitis.* Some cases mimic diphtheria somewhat closely owing to the fact that several patches of exudation in the tonsillar lacunæ may coalesce into a larger patch; but the presence of other white points is in favour of tonsillitis, and the exudation on removal leaves no bleeding surface such as occurs in diphtheria. A sore throat of several days' duration, without membrane formation, is rarely diphtheritic.

On the other hand, diphtheria occasionally presents a picture which may be quite indistinguishable from follicular tonsillitis; but this is rare. The mode of onset is of help, being much more severe, with higher temperature and marked pain on swallowing, in tonsillitis, as contrasted with the comparatively

insidious onset of diphtheria. The presence of extensive membrane may be regarded as diagnostic of diphtheria, as also is any extension of membrane on to the uvula and soft palate. A doubtful throat with added laryngeal symptoms is almost certainly diphtheritic.

In the severe forms of septic tonsillitis there is much greater œdema of the fauces, and the onset and constitutional symptoms are very severe.

2. From *Vincent's angina*. This is an acute febrile illness with spreading ulceration of the tonsils, often involving the uvula and soft palate and sometimes the tongue. A soft yellowish-green slough appears, which on removal leaves an ulcer. Diphtheria rarely causes sloughing or ulceration of the fauces, and, further, in Vincent's angina, the diphtheria bacillus will not be found.

#### (b) *Laryngeal form*

This commonly occurs in children and seldom in adults. The early symptoms are a harsh laryngeal cough, hoarseness, and occasionally loss of voice, followed by symptoms of respiratory obstruction, such as stridor and retraction of ribs.

*Diagnosis.* In the presence of membrane on the fauces the diagnosis is certain, but sometimes laryngeal diphtheria occurs alone or the faucial exudate may have disappeared when the patient is first seen.

The problem that presents itself is, then, the diagnosis of the cause of an increasing respiratory obstruction. The subject is fully discussed in Chapter X. The question of diphtheria is practically concerned with children alone. Briefly, the pharynx should be examined for a retropharyngeal abscess, and the possibility of a foreign body should never be forgotten. Nor, again, can it be emphasized too strongly that, owing to the insidious mode of onset of diphtheria, respiratory obstruction may be the first sign to attract attention.

*Measles* is occasionally ushered in with severe laryngitis. In the absence of membrane on the tonsils attention should be paid to the presence or absence of general coryza. A nasal discharge alone is suggestive of diphtheria rather than measles. The buccal mucous membrane should be carefully examined for Koplik's spots.

*Catarrhal laryngeal spasm.* See p. 197.

*Acute laryngitis.* An isolated attack of acute laryngitis is not uncommon in children, and in the absence of faucial inflammation the diagnosis may be impossible. A swab from the throat

should always be taken, and serum injected at once without waiting for the result of the bacteriological examination.

(c) *Nasal form*

This may occur together with the faucial form. There is an irritating watery or muco-purulent discharge which is frequently blood-stained.

It is also apt to occur in a very chronic form. Large pieces of membrane may be expelled, and constitutional symptoms are very slight. It is important, however, to be on one's guard with any chronic nasal discharge owing to the risk of infection to others. A unilateral discharge is usually non-infective, and careful examination should be made for a foreign body.

6. MUMPS

The distinctive feature is a swelling corresponding to the position of the parotid gland. It begins below and in front of the ear, extends downwards below the angle of the jaw and the swelling in this region is accentuated by the fact that the submaxillary gland is also commonly affected. The swelling extends forwards over the masseter and also causes a very characteristic outward displacement of the lobe of the ear. The depression between the angle of the jaw and the sterno-mastoid muscle is obliterated. The swollen gland is very tender on pressure, and mastication is painful. The overlying skin is rather glossy and pale, or it may be slightly reddened. Both sides are usually involved, the second often only when the swelling of the other side is subsiding. The swelling usually subsides in a week, suppuration is almost unknown, and fever is usually mild. In severe cases the swelling is very marked and practically encircles the neck.

Mumps has to be diagnosed from :—

(a) *Secondary parotitis*. This is seen as a somewhat rare complication in numerous disorders, such as enteric fever, pneumonia and pyæmia; it is not very rare in disease, injury or sepsis of the abdominal and pelvic organs; and also in cases undergoing rectal feeding. It may be due to infection carried by the blood-stream or up the parotid duct from the mouth. The diagnosis rests on the presence of some condition known to predispose to secondary parotitis, and on the facts that it is usually unilateral and that it not infrequently ends in suppuration.

(b) *From acute enlargement of lymphatic glands*. In inflammation of the cervical glands the hollow between the sterno-

mastoid and the jaw is not obliterated as it is in mumps, and the swelling does not spread above the level of the zygoma. The commonest causes of an acute enlargement of the glands that would be likely to give rise to error are the various acute affections of the tonsils, such as follicular tonsillitis, diphtheria, and scarlet fever. In any case the throat should always be examined, for the presence of any form of tonsillitis would at once raise doubt as to the existence of mumps.

(c) *From cellulitis or abscess.* We have seen a case of Ludwig's angina which at the onset was regarded as mumps. The higher fever and the rapid development of a brawny swelling involving the side of the neck speedily settled the nature of the trouble. In another case, a local periosteal abscess just above the angle of the jaw simulated mumps closely until signs of suppuration developed.

## 7. SMALL-POX

*Onset.* The onset is severe, with rigors in adults or convulsions in children, intense headache, and severe lumbar pains. Vomiting is common and the temperature rapidly rises to 103° or 104° F.

*Prodromal rashes.* These are fairly common and appear usually at the end of the first day or during the second day of illness. There are numerous varieties, the more important of which are :—

(a) *Scarlatiniform.* This is the most common of the prodromal rashes. It may cover the whole body, including the face; it is usually fugitive and is seen especially in cases modified by vaccination.

(b) *Morbilliform.* This may resemble measles very closely.

(c) *Local erythemata,* especially on the lower abdomen, groins and flanks.

(d) *Petechial.* The commonest site is the lower abdomen, forming a rough triangle with its base above the umbilicus; the inner sides of the thighs are often affected. The petechial rash may be associated with an erythematous or erysipelatous blush; it comes out in successive stages and is of grave import.

*The eruption. Discrete form.* The rash proper usually occurs on the third day. Small red spots, which quickly become shotty to the touch, appear on the forehead and wrists. The trunk, legs, and arms are soon involved. With the development of the rash the patient's condition improves markedly and the temperature falls.

On the fifth or sixth day the papules are converted into umbilicated vesicles, which become definitely pustular by the eighth day. There is an areola of injection around the pustules. The face and hands are often very swollen. The temperature rises again and insomnia and delirium are common. By the tenth or eleventh day the fever has subsided, as a rule, and the pustules are drying up, leaving scabs of a light or dark brown colour which are subsequently exfoliated.

*Confluent form.* The rash is more profuse and the constitutional symptoms are much more severe. The rash becomes confluent during the stage of vesiculation or early pustulation. The stage of remission of fever is less marked. The skin is much swollen, especially of the face, eyelids, and hands. When suppuration has fully developed, the skin of the head and limbs resembles a superficial abscess. The cervical glands are greatly swollen. The temperature rises to  $104^{\circ}$  or  $105^{\circ}$  F.; delirium is usual; salivation is common in adults, and diarrhoea in children. In fatal cases death is preceded by a typhoid-like state.

*Hæmorrhagic form.* (a) *Purpura variolosa.* Constitutional symptoms are very severe. Initial rashes are common, especially in the groins. The rash extends and is hæmorrhagic; the skin is dotted with purpuric spots varying in size, or large hæmorrhagic areas develop. Subconjunctival hæmorrhage is common, and bleeding may take place from the mucous surfaces. Death may occur before the papules develop, and usually occurs between the third and sixth days.

(b) *Variola pustulosa hæmorrhagica.* In some severe attacks of small-pox hæmorrhage occurs in and around the pocks at the vesicular or pustular stage. The earlier this occurs the greater the danger, and the majority of the cases prove fatal.

*Small-pox modified by vaccination (varioid).* The onset is usually milder than in the unvaccinated, but may be severe. The rash is scanty as a rule, and as it appears the temperature usually falls rapidly and the patient feels practically well. Many of the pocks abort in the papular or vesicular stage, and those that reach the pustular stage quickly desiccate. There is usually no secondary fever.

*Diagnosis.* In the presence of an epidemic, small-pox is not very likely to be overlooked; the risk is rather that other cases of acute illness will be notified as small-pox.

With sporadic cases, however, the difficulty may be very great,

at any rate until the characteristic eruption appears. This is partly due to the fact that the disease is fortunately rare and therefore unlooked for; but with the increase in the number of the unvaccinated it may become an important factor in general practice, on account of the urgent need for isolation and for prompt vaccination of contact cases.

Errors of diagnosis occur (*a*) at the onset and during the first three days, and (*b*) in the eruptive stage.

(*a*) *The onset.* This is nearly always severe. The chills and the pains in back, head, and limbs are very characteristic. In the presence of such symptoms vaccination marks should always be looked for. If good marks are present, and especially if revaccination has been done, small-pox is improbable. In an unvaccinated subject the possibility of small-pox should be suspected. The patient's occupation may give considerable assistance. A tramp may have brought the disease from a distant town, for as the incubation period is about twelve days, there is abundance of time for the patient to have travelled long distances, even on foot.

A severe attack of influenza resembles the onset of small-pox very closely, and if the patient is unvaccinated the diagnosis may be impossible until determined in a few days by the absence of the rash.

The initial rashes may be a source of difficulty. The triangular rash above described is distinctive of small-pox. The scarlatini-form rash has been mistaken for scarlet fever, but it is never so persistent, and there is little or no sore throat. The rash of measles has been mistaken for the initial macular rash of small-pox, and vice versa. The safest indications are the general coryzal symptoms of measles and Koplik's spots (see p. 86).

Hæmorrhagic small-pox in an epidemic could not be overlooked. An isolated case might be mistaken for purpura, but in the latter the onset is not so severe. It might be impossible to distinguish between hæmorrhagic small-pox and the hæmorrhagic form of scarlet fever and diphtheria, especially if death occurred before the development of the characteristic small-pox eruption. It has also been mistaken for cerebro-spinal fever, in which a petechial eruption is not uncommon.

(*b*) *The eruptive stage.* In a severe attack of small-pox the papular, vesicular, and pustular stages are very characteristic. When modified by vaccination it is, however, apt to be overlooked. Chicken-pox has given rise to many errors.



In the table<sup>1</sup> on the next page the differential diagnosis between a mild attack of small-pox, small-pox modified by vaccination, and chicken-pox, is given in tabular form.

Certain skin affections have been mistaken for small-pox. Among these may be mentioned pustular syphilides, iodide rashes, impetigo contagiosa, and pemphigus. It is impossible to enter here into the differential diagnosis of these conditions. They should not be mistaken for small-pox in an unvaccinated subject, in which the constitutional symptoms are in the majority of cases extremely severe. A mild case of modified small-pox, however, might be mistaken for one of the above conditions, and vice versa; but even when modified by vaccination the onset of small-pox is commonly rather severe. A history of syphilis or of iodide treatment will clear up many cases.

It is clear that in some cases the diagnosis of small-pox is very easy, but in some most difficult. In doubtful cases the prompt isolation of the patient and immediate vaccination or revaccination of contact cases is imperative.

#### GENERAL MANAGEMENT OF AN INFECTIOUS DISEASE

Spread of infection has to be guarded against. This risk is minimized by isolation of the patient and by the disinfection or destruction of infective material.

*Isolation of the patient.* This is frequently effected by removal of the patient to a fever hospital. Small-pox cases should always be removed. Scarlet fever, diphtheria, and enteric fever are the cases ordinarily met with which are admitted. Typhus is admitted, but is a rare disease. Measles, German measles, chicken-pox, and mumps, are not usually eligible, but some of these diseases are commonly present in the wards of a fever hospital through errors of diagnosis, or by reason of measles and diphtheria, for instance, occurring together in the same patient.

In the case of persons living in crowded houses or tenements removal to hospital is imperative.

In houses with ample accommodation an infectious disease can usually be dealt with safely without removal. Two rooms with bath-room and lavatory should be reserved for the sole use of the patient and nurse. All unnecessary furniture and hangings should be removed.

<sup>1</sup> Modified from Biernacki's article on Small-pox in Bain's *Textbook of Medical Practice*, 1904.

<i>Mild Small-pox</i>	<i>Small-pox modified by Vaccination</i>	<i>Chicken-pox</i>
1. Occurs at an age in unvaccinated subjects.	1. Occurs with extreme rarity within seven years of efficient vaccination.	1. Far commoner under ten years.
2. Marked initial fever, backache, headache, pains in limbs; fever subsides when rash appears.	2. Often marked fever.	2. Initial symptoms nearly always trivial.
3. Prodromal rashes not rare; typical triangular rash practically decisive.	3. The same holds, but rashes usually of milder type.	3. Rarely a prodromal scabiform rash.
4. Specific rash first on face. More spots relatively on face than on trunk, on back as compared with front of body, on distal as compared with proximal parts of limbs. Papules deeply embedded, shotty, conical and circular. Too much importance not to be attached to shottiness.	4. Distribution apt to be aberrant. Perhaps only two or three spots on trunk or elsewhere. Papules not shotty at first; tendency to imperfect development; may be indistinguishable from chicken-pox.	4. Rash usually noted first on face. More likely to be typical on trunk in every stage. Relatively more profuse on trunk than face; sparse on limbs and on their proximal as compared with distal parts. Many papules may not proceed to vesiculation, some remaining mere red points, slightly raised. Successive crops usual in same areas, so that spots in all stages of development occur together. Marked multififormity is a valuable diagnostic point. Papules when typical are softer, less deeply embedded, less uniformly circular, usually less conical. Vesicles may apparently form without previous papulation.
5. Vesiculation discernible after papules have been out forty-eight hours or a rather shorter time; four days longer before complete. Typical vesicles are deeply embedded, thick-walled, flattened, often umbilicated, not easily ruptured, not readily emptied on puncture. Round in outline and fairly uniform in size.	5. Vesiculation may begin towards end of twenty-four hours, and occupy two or three days. Vesicles vary greatly in character in different cases. Vesicles usually smaller than in unmodified small-pox and ill developed; occasionally apical; often spheroidal, slightly oval. Perhaps none show umbilication.	5. Vesiculation within few hours. Usually complete and contents turbid within twenty-four hours. Typical vesicles superficial, thin-walled, tense, not flattened or umbilicated, the last two conditions being quite exceptional. Vesicles are readily ruptured. They may lose some of their contents and become flaccid. Easily emptied on puncture. Less uniform in size. Some on papular base, others as mere blisters on normal skin.
6. Nearly all pocks become pustular. Confluence characteristic of profuse rash.	6. A small proportion may become pustular, or whole rash may abort in vesicular or conipustular stage. Rash does not in majority of cases	6. Most vesicles dry up quickly after about twenty-four hours when merely turbid. Here and there one may puritulate. But no confluence not a feature even with profuse rash.
7. Scarring often deep.	7. Scarring rare.	7. Where scarring the mark, in typical form, is very shallow.

## METHODS OF DISINFECTION

*During the illness*

A sheet moistened with carbolic acid should be hung across the door of the sick room, or, better, across the passage giving access to it. Apart from any actual destruction of infective material this has a salutary influence as a barrier to children, should it have proved impracticable to remove them from the house.

*Dust* should be removed by a duster moistened with 1 in 20 carbolic acid. Sawdust similarly moistened should be sprinkled on the floor for sweeping purposes. Both duster and sawdust should be burnt. In summer weather a fire should be kept burning in an adjacent room for the purpose of destroying infected material.

*Discharges* from mouth and nose should be received into pieces of rag, which should be burnt.

*Sputum* should be received into a vessel containing 1 in 20 carbolic acid, and should remain in this for half an hour before being thrown down the drain.

*Excreta.* In cases of enteric fever the evacuations should be received into vessels containing a 1 in 20 solution of cresol. Urine bottles should contain 5 oz., bed-pans 10 oz. of the solution. The stool should be stirred into the disinfectant with a stick, which should then be burnt. One hour should elapse before the evacuation is thrown down the drain.

Should nephritis occur in scarlet fever the urine should be treated in the same way.

*Food.* It need hardly be said that milk or any article of food taken into the sick room and not eaten should be destroyed.

*Flies.* These must be regarded as active carriers of infection. They are very prone to cluster round a sick bed. Fly-papers should be kept in the room and frequently burnt and replaced.

*Linen.* All soiled linen should be soaked for four hours in a 1 in 20 solution of carbolic acid and should subsequently be boiled.

*The patient.* As soon as the patient is sufficiently recovered he should have frequent baths.

*Final disinfection of sick room and contents*

Articles of small size and of little value are best burnt. No valuable books should be allowed in the sick room, as burning is the safest precaution. The patient's personal clothing should

either be burnt or sterilized by heat. In many cases it is simplest to send bedding and clothing to the local sanitary authorities.\*

Formaldehyde is one of the most reliable disinfectants. Permanganate of potash is added to formaldehyde solution, and the two are obtainable commercially in quantities requisite for 1,000 cubic feet; in order that the gas evolved by the mixture may not diffuse out of the room too quickly, the chimney must be blocked up, and all interstices in doors and windows should be papered over as far as possible; the room should be left for twelve hours and then all the windows widely opened. The whole room should then be scrubbed thoroughly, and it is wise to repaper and whitewash.

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#### SCHOOL ATTENDANCE

Infectious diseases in their relation to school life must be considered from two points of view:

1. *Duration of infection.*
2. *Contact cases.*

##### 1. *Duration of infection*

The average duration of infection for the ordinary infectious diseases can be stated approximately, but owing to the favourable opportunities presented by crowded classrooms for the wide dissemination of disease, an additional period has to be added before a child can be allowed to return to school. The ordinary period for which a case must be regarded as infectious may be much prolonged by persistence of discharges from nose and ears. In the case of scarlet fever the opinion is gaining ground that desquamation in itself is not to be regarded as evidence of infectiousness, but from the point of view of school attendance it is wise to be on the safe side and regard the peeling stage as infectious.

In many cases after recovery from an infectious fever the convalescence is prolonged, and return to school may be delayed far beyond the time at which the question of the possibility of infectiousness has to be considered. In many cases, however, the illness is very slight and the patient is well in a week or so.

In the following table the average duration of infection is

given in the second column and the date at which school attendance may be resumed in the third.

<i>Disease</i>	<i>Duration of Infection</i>	<i>Date at which School Attendance may be resumed</i>
Scarlet Fever.	About six weeks, conditional on absence of aural or nasal discharge or of nephritis, and on completion of peeling.	Not less than eight weeks from onset of rash, and then only in the absence of discharges.
Diphtheria.	At least three weeks.	Not less than six weeks from beginning of illness, and then only in the absence of discharge from nose, eyes, and ears.
Measles.	Three to four weeks.	Not less than four weeks from beginning of rash.
German Measles.	Two weeks.	Three weeks from beginning of rash.
Small-pox.	About four to five weeks. Until every scab has fallen off, and the skin lesions have all healed.	When every scab has fallen off.
Chicken-pox.	About two weeks. Until every scab has fallen off.	Four weeks.
Mumps.	Three weeks.	Four weeks from the beginning. At least one clear week must have elapsed since the subsidence of swelling.
Whooping-cough.	Very variable—until the cough has absolutely ceased.	Two weeks after disappearance of the cough.
Enteric Fever.	Very variable.	

## 2. *Contact cases*

Apparently healthy children in infected houses must not attend school. This is obvious, as they may be incubating the disease. Further, as they are exposed to the possibility of infection until the complete recovery of the patient and the disinfection of the house, they must be quarantined for the full incubation period of the disease reckoned from that date. Unfortunately incubation periods vary within rather wide limits, so that the maximum incubation period of each disease must be selected. In the case of diphtheria, persons exposed to infection may carry diphtheria bacilli in the mouth or nose, and convey the disease to others without being ill themselves. The quarantine period of a diphtheria contact case should therefore be much longer than the incubation time.

In the case of children not living in the same house, but who have been exposed to the possibility of infection, as, for example,

by playing in a house with a child suffering from a 'cold' who next day develops a measles rash, quarantine is wise. Each case must be treated on its merits. The degree of contact must be considered, whether in the house or open air and so forth. If the 'contact' has previously suffered from the disease, quarantine need not be enforced.

In the following table the common incubation period is placed in the second column, the maximum incubation period (for quarantine purposes) in the third.

<i>Disease</i>	<i>Average Incubation Period</i>	<i>Duration of Quarantine of Children exposed to Infection</i>
Scarlet Fever.	3 days.	10 days.
Diphtheria.	2-4 days.	For children living in infected house, 28 days. For contact cases, 12 days.
Measles.	10 days.	16 days.
German Measles.	10-12 days.	20 days.
Small-pox.	12 days.	16 days.
Chicken-pox.	14 days.	20 days.
Mumps.	14-21 days.	24 days.
Whooping-cough.	7-14 days.	21 days.
Enteric Fever.	14-21 days.	21 days.

#### TREATMENT OF CERTAIN EMERGENCIES ARISING IN THE COURSE OF ACUTE SPECIFIC DISEASES

##### *A. Arising in the course of any fever*

##### 1. HYPERPYREXIA

With a very high temperature, 106° F. or more (hyperpyrexia), the prognosis is exceedingly grave; but sleeplessness, restlessness, and delirium may be present with a much lower temperature, 102° to 103° F. for instance, and very great relief follows treatment by sponging, wet packs, or baths. This form of treatment should therefore be employed in the presence of those symptoms whether or not the temperature has attained a high level, and in their absence a general rule may be adopted of sponging the patient when the temperature reaches 102·6° F.

*Sponging.* The patient should be wrapped in a blanket and the limbs and trunk should be thoroughly sponged for five minutes each with a sponge partly wrung out of cold water.

*Wet pack.* The patient is wrapped in a sheet wrung out of water at a temperature of 75° F. At the end of half an hour he should be rapidly dried and placed between blankets.

*Baths.* In the case of adults great difficulties are experienced owing to the weight of the patient; in children this treatment is easily carried out. The water should at first be warm, even 100°. The patient is then lowered carefully into the bath, and cold water allowed to run in until the temperature of the water is lowered to about 80°. In the case of hyperpyrexia ice should be added and the temperature brought down to about 65°. If water at a temperature below 80° is employed the patient should be given a stimulant, such as *sp. ammon. aromat.* ʒ ss, *sp. ætheris* ʒ ss, *aq. ad* ʒ j, just before the bath, and the limbs should be rubbed vigorously whilst he is in it. The period of immersion should be from fifteen to thirty minutes, but the patient must be removed at once if any signs of collapse appear.

If a bath is not available hyperpyrexia may be treated by the wet pack with pieces of ice laid over the abdomen, and an ice-bag may be applied to the head.

## 2. INSOMNIA AND DELIRIUM

Sponging and the wet pack should be tried, and are often followed by sound sleep. Hypnotics are, however, often necessary in addition. Potassium bromide, gr. xv, with chloral, gr. x, may be given an adult; bromide, gr. x, and chloral, gr. v, for a child. Sulphonal, gr. xx, or trional, gr. xv, may also be given to an adult. If these drugs fail recourse must be had to opium, Dover's powder is often very satisfactory, or a hypodermic injection of morphia may be given.

### *B. Arising in the course of particular fevers*

#### 1. DIPHTHERIA

The treatment of diphtheria by *antitoxic serum* is so important, and its use at as early a date as possible is so imperative, that it should be regarded as emergency treatment. Serum should be given if there is any suspicion of diphtheria, without waiting for results of bacterial cultivation. If given in the first twenty-four hours it reduces the mortality of diphtheria practically to nil. In a mild case, seen on the first day, 2,000 units should be injected. In a more severe case, or in one seen at a later stage, 8,000 units must be given. A further dose of 4,000 units should be given on the following day if the membrane increases. In bad cases, with few or no signs of improvement, another 4,000 units should be given on the third day. It should be injected into the subcutaneous tissue of the flanks.

A child who has been sleeping with another who develops diphtheria should be given an injection of 500 units as a prophylactic measure.

(a) *Laryngeal obstruction.* Diphtheria is, of course, the commonest cause of respiratory obstruction in children, although the frequency of this complication, and particularly the need for tracheotomy, have been markedly diminished since the introduction of the antitoxin treatment. In a case which has escaped diagnosis, or in which the antitoxin has been used too late, the onset of respiratory obstruction, although sometimes rapid and almost sudden, is more often gradual, so that, if the case is being watched, the right moment for surgical interference can be selected. In hospital practice it is not uncommon for a child, when first brought up, to be actually *in extremis*, and tracheotomy has then to be performed with the utmost dispatch and without a certain diagnosis of diphtheria. Nevertheless, even in the most desperate case, a digital examination of the pharynx should invariably be made, lest a retropharyngeal abscess be mistaken for diphtheria.

It must be pointed out, however, that, even when the condition is very urgent, the operation need never be done so hurriedly as to be done badly. Of no undertaking can it be more truly said, 'More haste, less speed.' We have seen the trachea opened whilst the engorged veins were still bleeding, with the result that the child, giving a great gasp, sucked in enough blood literally to drown itself.

When it becomes necessary in a less severe case to give relief by surgical intervention, there are two courses open, namely intubation and tracheotomy. We do not propose to discuss the relative value of the two operations. It is enough to say that the difficulties of intubation in unpractised hands, not only in the actual performance but also in persuading the tube to remain in place, together with the risk of pushing membrane down in front of the tube, have led the majority of surgeons to abandon intubation as a routine measure in diphtheria. Tracheotomy is undoubtedly easier for those who have had no special practice with intubation, and on the whole the balance of opinion lies in its favour.

*High and low tracheotomy.* Of the two operations (see p. 200) the latter is to be preferred, although slightly more difficult of performance. The farther below the larynx that the incision into the trachea is made the easier is the after-treatment, and, with the low operation, there is rarely any difficulty experienced in



leaving out the tube, such as occasionally occurs after the high operation. The silver tube should not be allowed to remain in for more than twelve or twenty-four hours. If a tube is necessary after that time, a rubber one should be employed.

Should the tube become blocked with mucus, blood-clot, or membrane, no attempt must be made to clear it whilst *in situ*. The evil custom of pushing a feather down the tube has been rightly abandoned. The inner tube must be taken out and cleared, and, if this fails to secure a free air-way, the whole tube must be removed and the trachea held open with the dilators whilst the tube is being cleaned. This treatment will often allow the child to cough up, through the tracheal wound, a piece of membrane which could not be expelled through the tube.

(b) *Cardiac failure*. Certain unfavourable factors predispose to death from toxæmia in an early stage, or later from cardiac failure. Among these factors may be mentioned the presence of widespread or persistent faucial membrane. Much glandular swelling is another indication of severity. Local hæmorrhages from the throat, renal hæmorrhage, and cutaneous purpuric spots are of grave import. Caiger has never seen a patient recover in whom purpuric spots appeared as a primary and independent phenomenon. Finally, the prognosis is markedly dependent on the time at which antitoxin is administered.

The circulatory symptoms which attract attention are irregularity of pulse; a quick pulse, especially when associated with a normal or subnormal temperature; or a slow pulse. The left ventricle may dilate and an apical systolic murmur may be heard. The heart sounds are faint and the normal pause after the second sound may be shortened, the cardiac rhythm assuming what Caiger calls the 'tic-tac' character. These symptoms are usually first noticed early in the second week of illness. Vomiting is a common accompaniment and is a very grave sign. Nothing can be kept in the stomach, and retching is apt to be frequent even in the absence of attempts at feeding. Restlessness is common, and pallor comes on with precordial oppression. The urine becomes scanty and albuminous.

*Treatment*. The tendency to cardiac failure should be borne in mind in cases presenting unfavourable faucial and other features at the onset of the illness as above described, and the slightest signs of circulatory failure should be carefully watched for.

Absolute rest is the most important measure. The patient should not be allowed to do anything whatever for himself. Digitalis and strophanthus are of little use. Hypodermic injec-

tions of strychnine should be tried. Adrenalin is well worth trying on account of its stimulating action on the heart. It may be given by the mouth in 5-minim doses of adrenalin solution (1 in 1,000) every four hours, or in doses of 15 minims with each rectal feed. Unfortunately it is doubtful whether its activity is retained when administered by mouth or rectum. It may be given hypodermically in smaller doses, 2 minims at a time. Alcohol in small quantities may be tried, champagne being the most suitable form. If there is much cardiac pain and restlessness small doses of morphia should be given.

Coldness of the extremities should be treated by hot bottles and rubbing. Intravenous infusion of saline is of doubtful value, for the addition of fluid may further embarrass the heart.

(c) *Diphtheritic paralysis*. This is most likely to occur in cases of a severe type, and in those in which antitoxin is not administered at an early date.

Attention is usually drawn by a nasal intonation of the voice indicative of weakness of the palate, or by difficulty in swallowing fluids, which are apt to regurgitate through the nose. Weakness of accommodation and squints are common. Later the legs become weak, with loss of knee-jerks, and in severe cases the paralysis may be very widespread.

*Treatment*. Absolute rest in bed must be enjoined. If liquids cannot be swallowed, milk and other food should be given in the form of jelly by the use of isinglass, or cornflour may be used. In bad cases food must be given through a rubber tube passed through the nose down the œsophagus. Nasal feeding should always be resorted to if swallowing is attended by coughing owing to food entering the larynx. When vomiting is present in addition, rectal feeding must be employed. Strychnine is valuable and is best given hypodermically. Finally, in prolonged cases with weakness and wasting of limbs massage and electricity should be employed.

## 2. ENTERIC FEVER

(a) *Tympanites*. Great care must be taken to determine that the distension is due to tympanites and not to perforation and peritonitis (see Chapter XIII). Sometimes it is extreme, and it may recur frequently in the same case. It may develop very rapidly and cause considerable pulmonary and cardiac embarrassment. A soap enema, containing  $\frac{1}{2}$  to 1 oz. of turpentine, often gives prompt relief; or half a drachm of oil of rue with 3 oz. of glycerine, and soap enema to a pint, may be used. A

long rubber tube passed *per rectum* sometimes acts successfully. An ice-bag to the abdominal wall should also be tried. In a series of 147 cases treated with oil of cinnamon from the time of coming under treatment until the temperature had fallen to the normal, Caiger did not observe a single case of meteorism. It was given at first in doses of  $2\frac{1}{2}$  minims every two hours, and increased in the course of a few days to 4 or 5 minims.

Marked improvement may occur after the relief of severe tympanites; the pulse improves, restlessness and delirium may cease at once and be followed by quiet sleep.

(b) *Perforation.* See p. 254.

(c) *Hæmorrhage.* In mild cases an ice-bag should be placed on the abdomen. Rectal injections of iced water are also useful. If there is much restlessness morphia should be given hypodermically, but inasmuch as perforation sometimes occurs with hæmorrhage, signs of this should be carefully watched for, and the influence of opium in obscuring the early signs of peritonitis should not be forgotten. In very severe cases intravenous injection of normal saline should be used, the extremities wrapped in cotton-wool, and hot-water bottles applied.

### 3. LOBAR PNEUMONIA

Pneumonia is so important a disease, and the mortality so great, that every case should be regarded from the onset as an emergency. The intensity of the toxæmia is by no means proportional to the area of lung involved; death often occurs with only a small amount of consolidation of the lung, and on the other hand extensive consolidation may be attended by mild constitutional symptoms. An apparently mild attack may become very serious from the supervention of complications.

It is most important, therefore, that no effort should be spared from the very beginning to conserve the strength of the patient, to supply him with adequate nourishment, to relieve pain, and to treat symptoms generally.

The room should be well ventilated, and the temperature kept at from 60° to 65° F. Visitors are most undesirable, as talking is very exhausting to a patient with pneumonia. The mouth should be washed several times a day with a mouth-wash such as 'Listerine'. A cotton-wool or gumgee-tissue jacket is advantageous, but heavy bedclothes are undesirable. The patient should be sponged over daily with tepid water. Sitting up in bed ought not to be allowed; examination of the back of the lung can be made by rolling the patient over on to his side.

The bowels should be well opened at the beginning of the illness by a dose of five grains of calomel, followed in the morning by a saline purge.

The food should consist in the first place of milk; two pints is a fair quantity, part of which may be given as custard or junket. One egg should be given, either in custard or beaten up in milk. A pint of beef-tea or chicken broth will complete all that is necessary in the way of food. If the patient wishes for more there is no reason against it, but if reluctant it is a mistake to force more, as the digestive capacity is much impaired. Food should be given every two or three hours in the day and about every four hours in the night. Water, barley-water, or lemon-juice and water may also be given freely, as thirst is often marked. It is a good thing to promote free action of the skin; a patient is much more comfortable when the skin is moist than when it is dry.

The onset of pneumonia is often attended by severe pleural pain, usually axillary. Two or three leeches will nearly always relieve this promptly: if not, a sixth of a grain of morphia should be given hypodermically and repeated once if necessary.

Sleep is most important, and during the first two or three days there is rarely any risk in giving ten grains of Dover's powder at night. Sleep shields the nervous system and enables the patient better to withstand the insomnia, restlessness, and delirium that may develop later in the course of the disease, when one may hesitate to give opium. Cold sponging is then most valuable and at the same time is useful in lowering the temperature. The patient should be sponged whenever the temperature reaches  $104^{\circ}$  F., and if it rises to  $105^{\circ}$  F. a cold pack may be given (see p. 99).

Tympanites is sometimes troublesome. It not only hampers the respiration but greatly increases restlessness and prevents sleep. Food should be withheld for a few hours and a turpentine enema given, or the rue enema mentioned on p. 103. Hypodermic injections of strychnine also seem to relieve it.

Cardiac failure is the most serious complication. At the earliest sign of weakness, and especially of irregularity, of the pulse, strychnine should be given hypodermically, gr.  $\frac{1}{30}$  every six hours, and every four hours if necessary. Digitalin, gr.  $\frac{1}{100}$ , is often combined with the strychnine. Alcohol should also be used, though it is not necessary as a routine in all cases of pneumonia; brandy, 4 or 6 ounces in the twenty-four hours, or champagne may be given. Alcoholic subjects with pneumonia

should not be deprived of alcohol, but should have fairly large doses of it. Sp. ammon. aromat. ʒj, sp. ætheris ʒ ss, aq. chloroformi ad ʒj, every four hours, is an excellent stimulant.

If the blood-pressure is taken regularly by a Riva Rocci or other instrument, a fall in the blood-pressure may be taken as a certain indication for stimulants.

If, despite treatment, the face becomes cyanosed, the jugular veins distended, the pulse very feeble and epigastric pulsation marked, venesection should be performed and about 10 ounces of blood withdrawn. Oxygen inhalations should also be given, and are often very useful in the earlier stages. Hypodermic injections of 2 or 3 minims of adrenalin solution (1 in 1,000) may be given, and rectal injections of normal saline.

In severe cases the danger is not over when the crisis occurs. The temperature falls and the patient may feel very cold. An extra blanket and hot bottles should be applied and stimulants continued, as fatal collapse is not unknown.

## CHAPTER VI

### BURNS AND SCALDS

A *burn* is defined as the lesion occasioned by dry heat, and a *scald* as that which results from the action of moist heat, upon the skin and mucous membranes. Except that scalds are usually of less severe degree, the distinction is not of any practical importance, and the term burn will here be used to denote both kinds of injury. Certain corrosive chemicals produce lesions which in effect are the same as those resulting from heat. The destructive effects of powerful electric currents are similar, but present certain special features.

Burns of the mouth and throat give rise to special symptoms and dangers. These are considered elsewhere (p. 192).

*Degrees of burns.* Burns are commonly described as being divided into six degrees, according to the depth to which they affect the tissues, but in practice it is not easy to distinguish them with any accuracy. Moreover, if an area of any considerable extent is involved, several degrees are always present together. The degree, broadly speaking, determines the mode of treatment, the amount of deformity which will remain, and to some extent also the severity of the constitutional symptoms.

A burn of the first degree produces only hyperæmia, and leaves no permanent mark. The second degree is that of vesication, in addition to the hyperæmia. Blisters of enormous size are sometimes produced, but complete recovery takes place and no trace may remain except perhaps a little brownish pigmentation of the skin. Burns of the third degree involve destruction of the superficial layers of the epidermis, but leave intact the deepest layers of epithelial cells lying between the bases of the papillæ. This is of the greatest importance, because regeneration will take place with great rapidity and with the minimum amount of scarring. The ultimate result of a burn of this degree is a whitish supple scar, perhaps with some amount of patchy pigmentation, but with little or no contraction or deformity. In the fourth degree the whole thickness of the skin is destroyed; in the fifth the subjacent muscles are also affected; and in the

sixth the bones are reached. The last three entail, after separation of the sloughs, healing by granulation, giving rise to the formation of much cicatricial tissue, and consequently often to very extensive deformity.

*Prognosis as regards life*

The following are the chief factors to be taken into consideration in forming an opinion as to the danger to life.

(a) *The degree of shock.* The initial symptoms are summed up in the word shock, and unless this can be speedily remedied the outlook is very grave.

(b) *Age.* The death-rate for burns in patients at the extremes of life is very high, infants especially exhibiting a mortality apparently out of all proportion to the extent of the lesion. During the years 1901 to 1904, 255 cases of burn and scald in children under 10 years of age were admitted into St. Thomas's Hospital. For those under 5 years of age the mortality was 27 per cent, whilst for those between 5 and 10 it was only 8 per cent.

(c) *Constitutional condition.* The alcoholic and those suffering from visceral disease or any form of debility succumb to the effects of burns much more readily than do the healthy, and are far more liable to pulmonary and other complications.

(d) *Extent and degree.* With regard to the immediate outlook, the superficial area involved is of far greater importance than the depth, but as regards the subsequent progress of the case it is the depth which is the more important factor, chiefly because of septic complications.

(e) *Situation.* Burns of the front of the chest and abdomen, and particularly of the genitals and perineal region, are far more dangerous than those of the back and limbs. Thus, a superficial burn involving a large area of skin, especially about the chest and abdomen, is more dangerous than a smaller burn of greater depth.

(f) *Sepsis.* Death may result from prolonged suppuration with its attendant toxæmia, or from septicæmia and pyæmia. Occasionally some specific infection develops and proves fatal. Bronchitis, broncho-pneumonia, and nephritis are of grave import.

*Treatment*

In the first place every effort must be made to overcome shock. The burnt area having been covered over temporarily, by preference with moist lint, the patient must be put to bed,

wrapped in warm blankets and warmed with hot bottles. Stimulants, of which strychnine is particularly valuable, must be administered either hypodermically or by the mouth. The foot of the bed may be raised, and the limbs may be bandaged, provided that they are not involved in the burn. If the patient does not quickly react to these measures, intravenous infusion should be performed. The addition of 10 minims of adrenalin solution (1 in 1,000) to the saline infusion increases very markedly its efficacy in cases of shock.

The treatment of the burnt area is of importance in relation to the shock, which is largely due to the exposure of nerve elements over a large area. Protection of the raw area is best attained by the application of lint soaked in a 0.5 per cent solution of picric acid, which coagulates the albuminous exudate and is supposed in this manner to form a protective covering to the exposed nerve fibres. The dressing should be kept wet by repeated applications of fresh picric acid lotion, but should not otherwise be disturbed for two or three days. After that time it will have accomplished all that it is capable of doing, and should be replaced by some other form of dressing. It is well to recollect when using picric acid that unsightly staining of the skin and hair may remain for several weeks. It should therefore be used with caution for burns of the face and head.

Unfortunately, when the patient comes under the surgeon's care, the burnt surface has usually been already covered with some greasy or oily substance or drenched with flour, forms of treatment which favour the supervention of sepsis. The application of these remedies is said to alleviate pain, but this is not a point of importance, as a bad burn gives rise to little or no pain on account of the accompanying shock. In fact, the degree to which pain is absent affords some indication of the severity of the shock.

Should the patient be seen immediately after the accident, the question of removal of adherent clothing will arise. Remembering that manipulation of the burnt surface tends to increase the shock, it is best to defer such removal until the shock has passed off. The adherent parts of the clothing, the rest having been cut away, are best removed by gradually soaking them off with warm boracic lotion or peroxide of hydrogen.

*Cleaning under anaesthetic.* This form of treatment, which in many cases gives excellent results, is applicable to severe and dirty burns, particularly where clothing is adherent, and when the surface is caked over with flour and grease. As soon as the



initial shock has passed off, the patient is anæsthetized, and the whole burnt surface and a large area of surrounding skin are thoroughly scrubbed with ether-soap, followed by alcohol or ether. The cleansed burn is then covered with lint soaked in picric acid solution.

The subsequent local treatment will be decided by the depth and situation of the burn. In the first two degrees a dry dressing of some powder, such as boracic acid or zinc oxide, or a mixture of the two in equal parts, covered over with a layer of cotton-wool, should replace the picric acid dressing. In the third degree a wet boracic dressing will probably be required for two or three days, in order to render the surface clean, after which the dry powder makes an admirable dressing. If the surface is permitted to remain sodden, healing is delayed. For burns of the first three degrees, and later for even deeper ones, the preparation known commercially as the 'Bardella' bandage is an excellent alternative. This is merely a bandage impregnated with a powder of bismuth, and is to be applied directly to the burnt surface. It may be allowed to remain in place for several days, and when removed, the burn is frequently found to be almost healed.

In the fourth and the still more severe degrees the separation of the sloughs and the subsequent healing are very apt to be attended with serious septic complications. Every care must therefore be exercised to prevent absorption, and nothing is better for this purpose than the *continuous bath*. This form of treatment is obviously most conveniently and easily carried out in the case of the limbs, but it can also be employed for the trunk. The patient may be immersed in a boracic bath for from a quarter of an hour to an hour twice a day. In preparing the bath it should be remembered that it is useless to throw the boracic powder into the water, because it merely floats upon the surface as an inert scum. The proper way is to mix the powder with a small quantity of water until a creamy fluid is obtained, in much the same manner in which domestic starch paste is made, and then to dissolve this in the bath. The water should be kept at a comfortably warm temperature the whole time. It must not be forgotten that prolonged immersion sometimes causes great exhaustion, especially in children and old persons, so that it is necessary to keep a very close watch upon the patient during the whole time that he is in the bath. If symptoms of collapse show themselves, the patient must be removed from the bath, and, the burnt surface having been covered over, put

back to bed between warm blankets. Stimulants may have to be given. The bath is often better borne on the second and succeeding days than at first.

After the sloughs have separated and the patient's general condition has been improved, the granulating surface should be grafted, because this not only hastens healing very considerably, but also to a large extent prevents or minimizes cicatricial contraction. The earlier this grafting can be done the less scar tissue will be formed, and consequently the less will be the disfigurement. Any tendency to cicatricial deformity must be carefully corrected by splinting, or by the weight-and-pulley extension in the case of the lower limb. Adhesions between two contiguous surfaces, such as the inner arm and chest, or between two fingers, can only result from negligence.

*Amputation.* *Primary* amputation is called for in burns of the limbs when the destruction is extensive, deep, and irremediable: when a joint has been opened into: and when the whole thickness of the limb is charred. Time must be allowed for the initial shock to pass off, lest the additional shock of the operation prove fatal. *Secondary* amputation may be required for local septic complications such as infective arthritis, osteomyelitis, or moist gangrene. It may also be necessitated by the severity of the constitutional symptoms either of toxæmia or pyæmia, or if, after prolonged suppuration, amyloid disease is threatened.

#### *Burns and Scalds in Special Situations*

1. *The eyelids, cornea, and conjunctiva.* See Chapter XXII.

2. *The mouth and throat.* Children are liable to inflict such injuries upon themselves by attempting to drink from a boiling kettle; others receive them from the inhalation of flame in burning buildings, and similar lesions are produced by swallowing corrosive poisons. The immediate dangers are shock, which may seem out of proportion to the injury, and œdema of the tongue, pharynx, and larynx, causing suffocation.

*Treatment.* The patient should be put to bed, with a tent and steam-kettle, and the shock treated. Tracheotomy instruments should be at hand in case urgent dyspnœa should supervene (see p. 192).

## ELECTRICAL INJURIES

The following remarks are based upon a paper by Sir Thomas Oliver.<sup>1</sup>

Currents of high voltage passing through the body from contact with live wires produce both internal and external effects.

(a) Death may be due either to inhibition of respiration followed by cardiac failure, or to primary cardiac failure.

In a case not instantly fatal treatment must be instituted at once, the most important measure being that of artificial respiration. Oliver cites the case of a workman resuscitated after an hour of artificial respiration even when life had been pronounced extinct by a medical man.

(b) Severe non-fatal burns are often attended by convulsions and loss of consciousness, and these patients are particularly liable afterwards to suffer from traumatic neurasthenia.

Locally, the characteristics of electrical burns are extensive destruction of tissue, slow spread of gangrene beyond the area immediately killed, much pain, and slow healing. The extent of the injuries may not be appreciated until the clothes have been removed. 'The boots, for example, may not exhibit any sign of injury, and yet on removing them the feet are found to be deeply lacerated and the bones exposed. Now and again it happens that a person receives a severe electrical shock, and at the time there are no external signs of injury, and no symptoms on the part of the nervous system. A few days afterwards signs of gangrene appear on some part of a limb, and removal of the affected portion by surgical means has to be adopted. . . . Operation after operation is performed in the hope of saving the patient's life, but the concealed internal injuries are so severe and of such an extensive nature as to baffle the resources of surgery.'

Injuries caused by lightning are of a similar character. Persons struck by lightning may be killed outright, or rendered unconscious for a variable period. After recovery of consciousness transitory paralyses may occur; less often permanent paralyses from cerebral hæmorrhage have been noted. The local injuries may be burns of a similar character to those above mentioned; injuries such as might be produced by a blunt cutting instrument, and fractures.

Treatment for these various injuries must be carried out on appropriate general lines.

<sup>1</sup> *Lancet*, Feb. 11, 1911.

## CHAPTER VII

### FRACTURES

MANY of the terms commonly applied to fractures are self-explanatory, and it would serve no useful purpose to enter into a discussion of them. Moreover skiagrams and operative inspection have modified many of the older ideas concerning the various types.

Whilst all these injuries are emergencies, yet a compound fracture is, other things being equal, of far greater importance and urgency than a simple one. An error in the initial treatment of a compound fracture may involve infection of tissue which may be followed by the most disastrous consequences. In this section therefore the compound fractures will be considered first.

#### I. COMPOUND FRACTURES

The essential feature in these cases is the presence of a communication between the broken bone and the exterior, through a wound in the skin or mucous membrane, by means of which micro-organisms may reach the site of fracture. This definition does not include the rare instances of infection of a simple fracture by way of the blood-stream from some septic focus elsewhere in the body. The wound of the soft parts leading down to the broken bone may have been made either from without inwards by the same violence as that which causes the fracture itself, or from within outwards by the projection through the skin of a sharp fragment of bone. The outlook in the latter class is as a rule better than in the former, partly because foreign material, such as portions of clothing, are not carried inwards at the time of the injury, and partly because the vitality of the tissues is not so much interfered with by bruising.

Some fractures are almost of necessity compound. Those involving the body of the lower jaw are almost invariably so, from laceration of the closely adherent gum; those involving the base of the skull, with external hæmorrhage, are necessarily compound.

*Diagnosis.* This rarely offers any difficulty, but now and then doubt arises when there is a wound of the skin in the neighbourhood of a fracture without any obvious communication between the two. Although it is highly important to make a diagnosis, no probing of the wound must be done, at any rate until after thorough cleansing; even then the procedure is of doubtful expediency, and is only to be employed after mature consideration of the risks involved. The safest rule is to treat a doubtful case as though it were compound, by thoroughly cleansing the wound and surrounding skin, applying an antiseptic dressing, and using a temporary splint (see p. 115).

#### *General Line of Treatment for Compound Fractures*

The key-note is cleanliness. If asepsis can be secured, the course of the case will be the same as that of a simple fracture. This is far more likely to happen if the damaged tissues are treated with gentleness and are not further injured by the indiscriminate use of chemical antiseptics.

Two main classes of compound fractures may be distinguished.

##### *1. The Less Severe Cases*

These are usually cases in which the fracture has been rendered compound by the projection of a sharp fragment through the skin. They are commonly unassociated with much bruising or other damage to the soft parts, and are most frequently met with in the lower limb, particularly in the case of the tibia.

*Treatment.* The cleansing of the skin and wound are to be carried out on the general lines laid down in Chapter IV. In cases where the bone is projecting through the skin, it may be necessary to enlarge the wound in order to effect replacement. It is seldom either necessary or advisable to remove any portion of bone. If there is much comminution, any small separated fragments should be removed, but pieces which retain any sort of attachment should be preserved.

The question of immediate wiring or plating sometimes arises, the argument being that as there is already a wound, the opportunity should be taken of securing the bones in apposition by means of some mechanical device. This we believe to be, in the great majority of cases, a mistake, partly because accurate adaptation without the intervention of soft tissues can conveniently be obtained by means of manipulation alone, and partly because the operation of wiring or plating adds both to

the time of exposure of the wound, and to the damage of the tissues, so that suppuration is encouraged. The conditions obtaining in a compound fracture differ from those of a simple fracture deliberately exposed in an aseptic operation, in that some degree of infection is almost certain to be present; the best chance for the tissues to overcome this infection lies in cleanliness combined with gentle handling, and the avoidance both of unnecessary manipulation and of the introduction of a foreign body.

When the wound has been thoroughly cleansed by copious washing with hot sterile saline solution, the bruised and torn skin edges should be pared away with a sharp knife, so as to leave a fresh clean-cut margin. Sometimes persistent venous oozing occurs during the operation; this can usually be controlled by hot saline irrigation, and the administration of oxygen by the anaesthetist, but if these measures fail the wound must be plugged with sterilized gauze. Whenever it is possible, the wound should be closed without drainage, but at the same time it is important that there should be no tension upon the stitches, which should be inserted neither so closely nor so tightly as to prevent exudation escaping between them. Less exudate occurs when a wound has been treated aseptically than when it has been drenched with chemical antiseptics; those therefore who use the latter find it necessary to provide drainage more frequently than those who do not.

A plentiful dressing of dry antiseptic gauze and wool is then applied. When a splint is necessary, as in the case of fractures of the bones of the limbs, it should be of such a kind that the wound can be easily inspected, with as little disturbance as possible. At this stage the position of the bones is of less importance than the condition of the wound.

If at the end of four or five days the general and local conditions indicate that the case is running an aseptic course it may be treated as a simple fracture.

If, on the other hand, suppuration occurs, the patient is exposed to the dangers, both local and constitutional, of infective osteomyelitis. Any degree of the infective process may be met with, depending upon the nature and virulence of the organisms present, and to a less, though by no means an insignificant extent, upon the constitutional condition of the patient.

Three main classes of infected compound fractures may be distinguished :—

(a) Those in which the infection is mild, in which the local signs of inflammation are slight, and in which little constitutional

disturbance occurs. In these cases it is sufficient merely to remove stitches, apply hot fomentations, and, immobilizing the limb upon some splint which allows of ready access to the wound, to await the separation of the small sequestrum which may be expected to result.

(b) Those in which severe constitutional symptoms, widespread cellulitis, extensive necrosis, or infection of a neighbouring joint occur. In such cases energetic treatment by free incisions and drainage, and bath treatment where practicable, may yet succeed in saving a limb. But if, in spite of all such measures, the fever continues and the patient is losing ground, amputation will have to be performed. The operation is rendered imperative if symptoms of pyæmia (p. 58), such as rigors and metastatic suppuration, begin to manifest themselves.

In both (a) and (b), treatment by Bier's hyperæmic methods may be given a trial, as excellent results have been obtained thereby (see p. 73).

(c) Those in which some specific micro-organism has invaded the wound. In such cases, as a rule, immediate amputation is required (see Tetanus, p. 77, and Empysematous Gangrene, p. 80).

## 2. *The More Severe Cases*

In young and healthy patients an attempt may be made to save a limb which in the aged or unhealthy would demand primary amputation. The factors of age and general health must therefore be taken fully into account when deciding between expectant treatment and immediate amputation. But there are some cases in which the local condition alone would indicate primary amputation, such as :—

(i) Severe crushes with extensive comminution of bone and laceration of soft parts.

(ii) Complete disorganization of a neighbouring joint.

(iii) Extensive laceration of tendons and nerves.

(iv) Rupture of a main artery, or such damage to blood-vessels as would render gangrene practically certain.

*Treatment.* (a) *Conservative.* The wound is to be cleansed and treated on the same lines as those described for the less severe cases of compound fracture. Crushed and lacerated pieces of skin, muscle, and fascia must be cut away, completely separated fragments of bone removed, and the whole wound freely irrigated with hot saline solution. If the skin wound is large, a few sutures should be inserted, but they should be loosely tied so as to avoid

all tension, and the wound should be drained either with rubber tubing or with Kocher's glass tubes, according to its size and depth. The limb is then placed upon a temporary splint which allows of easy access to the wound. If the wound is conveniently situated, as in the forearm or leg, the limb, splint and all, may be placed in a continuous boracic bath. Any sign of spreading cellulitis is the indication for free incision. In these cases also, treatment by Bier's congestive methods may give good results.

(b) *Amputation.* If *primary* amputation is decided upon, it should be done through healthy tissues as close to the site of injury as possible. The formal operations of the text-books are rarely either applicable or desirable, for it is better to fashion the flaps so as to use whatever undamaged skin and other tissues may happen to be available for the formation of a good stump. The flaps so made should be loosely sutured,\* and drainage provided.

*Secondary* amputation for infection after an attempt to save a limb has to be performed at a higher level than in the case of a primary amputation, in order to secure healthy tissue for the stump. In these cases one of the formal operations may be employed.

## II. SIMPLE FRACTURES

In treating a simple fracture, the objects to be kept in mind are (a) the restoration of the fragments to their natural position both in relation to one another and to the surrounding parts, (b) the maintenance of the correct position until union has taken place, and at the same time (c) the prevention of such disability as would arise from wasting of muscles, impairment of circulation, or adhesions in neighbouring joints and tendon sheaths.

(a) *Restoration of the fragments* to their natural position. Muscular spasm, effusion of blood, interposition of soft parts, and displacement of small comminuted fragments, may all play a part in preventing the accomplishment of this first essential. The last two difficulties may prove insurmountable without operative measures, but they form only a small proportion of the total number of fractures. If the bruising and swelling are considerable, which is more likely to happen with fractures from direct than from indirect violence, it may be advisable to wait for a few days before subjecting the limb to much manipulation, or applying a plaster of Paris splint. In such cases the limb should be fixed in as good a position as possible upon a temporary splint, perhaps with the addition of an ice-bag or an evaporating lotion dressing. Cold should, however, be used with caution, especially



in old persons, as it may interfere with the vitality of the skin. The sooner the fracture can be 'set' the better, and it is nearly always advisable to give an anæsthetic for the purpose. Indeed there are many fractures which cannot be satisfactorily dealt with without this assistance, whereby not only is pain avoided, but muscular spasm, the chief obstacle to replacement, is at once and effectually overcome. Thus the fracture can be freely handled, the best position obtained, and the splint adjusted with ease and accuracy.

(b) *The keeping of the bones in position* whilst union is taking place. Whether reduction has been accomplished by manipulation or by open operation, some form of retentive apparatus is usually necessary. This should always be of the simplest and lightest kind, and so applied as to cause as little pressure upon and constriction of the parts as possible. Some fractures require no splints, because the deformity does not tend to recur when once it has been reduced : of this class a Colles's fracture is a good example. Others, such as fractures of the upper end of the humerus, require very careful splinting, and for a given case several different kinds may have to be tried before a completely satisfactory one is found. It would serve no useful purpose to discuss the merits of a large number of individual splints, and equally good results can be obtained in many different ways. There are few fractures of the limbs which cannot be treated by plaster of Paris splints, and it will be convenient to describe their method of application here. The two methods most frequently employed are the plaster bandage and the Croft's splint.

(i) *The plaster bandage.* This is made by including the dry plaster between two layers of muslin, and rolling them together so as to form a bandage. When required for use, the bandage is simply soaked in water, applied wet, and allowed to dry. There are several disadvantages attached to this method. In the first place, unless the bandage has been freshly prepared, the plaster will have deteriorated by exposure to the air, so that it is necessary to prepare the bandages as required. Secondly, a splint so applied is much more difficult to remove than a Croft's splint.

(ii) *A Croft's splint* (Fig. 19) consists of two layers of some material such as household flannel, cut to the shape of the limb, and soaked in a cream made by mixing fresh plaster of Paris with water. The material should be so fashioned that, when the limb is enclosed within it, a gap of about an inch is left between its edges, along which the splint can subsequently be

cut for removal. The materials required are two or three bags of fresh plaster; some yards of household flannel; a large basin for mixing the plaster; a smooth board or table on which the flannel, after being soaked in the plaster cream, can be spread out; boracic powder; bandages both of flannelette and of ordinary domet, and various lengths of soft iron bars, one inch in width. When all is ready and the patient under an anæsthetic, the limb is well powdered with boracic. The fracture is 'set', and the limb, held in the proper position by an assistant, is completely enveloped with flannelette bandages, any bony prominences being protected with pads of cotton-wool. The plaster is next mixed. The basin should be half filled with tepid water, and the plaster

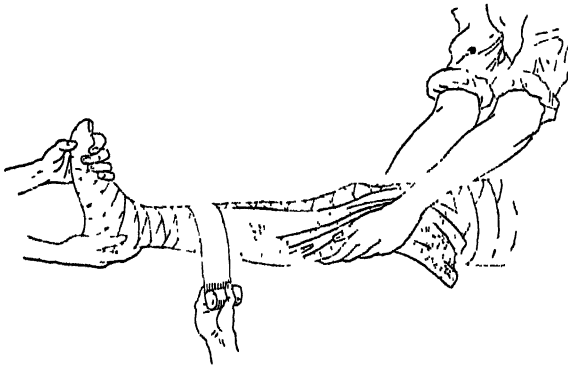


FIG. 19. Croft's splint applied to the leg.

gradually added and mixed with it until a fluid of the consistence of thick cream is obtained. Into this the shaped flannel is dipped, and squeezed so that the air is driven out and its place taken by the fluid. The material thus impregnated is then spread out evenly, fitted upon the limb, and bandaged in position. If iron bars are to be used for strengthening the splint, as is usually advisable, they are bandaged on outside this first layer, and the second layer of flannel, prepared in exactly the same manner, is bandaged on. The limb must be steadily held in position until the plaster has set. In a few minutes, if the right proportions of water and plaster have been used, the splint will be felt to become warm, a sign that it is setting, and after some five minutes it will be sufficiently hardened to permit of no displacement when the limb is left alone. When quite dry, another bandage should be applied, and varnished with starch paste. When it is desired to remove the splint, all that is necessary is to cut the bandages along

the interval that has been left for the purpose. This done, the plaster case can be removed unbroken, and reapplied if necessary. If the fracture is compound, a window can be cut in the casing after it has set, to allow for inspection and dressing of the wound; but it is easier to allow for this beforehand by cutting a window of the right size and shape in the flannel before soaking it in the plaster cream.

### *Operative Treatment of Simple Fractures*

Much difference of opinion exists as to the advisability of operating upon simple fractures, and whilst there are some who scarcely ever advise it, except in the case of the patella, there are others who argue that perfect restoration of the form of the bone cannot be obtained without it, and that any permanent alteration in the axis of a long bone will ultimately result in degenerative changes in the neighbouring joints. Much depends upon the situation of the fracture. Whilst union with even a marked degree of deformity in the case of a fracture of the shaft of the humerus is not incompatible with perfect use of the arm, even a slight degree of deformity persisting after a Pott's fracture will generally mean permanent lameness of a greater or lesser degree. It need scarcely be said that no operation upon a simple uncomplicated fracture is justifiable except in such circumstances as to render aseptic healing certain.

Operation upon simple fractures is required (*a*) to replace fragments which cannot be controlled by manipulation, (*b*) to restore the axis of a long bone when the ends cannot be brought into proper apposition or retained in position by other means, (*c*) to remove interposing soft structures which would render bony union impossible, (*d*) to ensure accuracy of reduction of fractures involving joints, and (*e*) to relieve pressure upon nerves or blood-vessels. Before embarking upon such an operation, it is necessary to have skiagrams taken from at least two points of view, in order that a correct idea may be obtained of the direction of the fracture and the position of the fragments.

*Operation.* The most rigid aseptic precautions being observed, an incision is made as nearly as possible over the site of the fracture, any important intervening structures being retracted. Any tissue interposed between the fractured surfaces having been removed, the bones are fitted accurately together. In some cases the fragments will remain in place without any mechanical assistance except that derived from external splints, but more often it is necessary to hold them together by means of

wires or screws. The best of these mechanical devices are Arbuthnot Lane's plates, which, being made of rigid metal and screwed against the bone, perform the function of internal splints.

In some cases an external splint is required to support the limb after operation, but it can soon be discarded and massage applied, sooner in fact than if the operation had not been done.

Screws and wire are apt to become loose from absorption of the bone around them, and, even apart from suppuration, they may have to be removed subsequently, although they often remain indefinitely without giving rise to any trouble.

### *Treatment by Massage*

This method of treating fractures is employed in two distinct ways, (a) as a substitute for, and (b) as an aid to, other forms of treatment.

(a) Splints are entirely abandoned, and the limb is merely kept at rest in bed between sand-bags. From the first day gentle massage is employed to the whole limb, and always in the direction of the venous flow. Also, from the first, the patient is made to move the neighbouring joints, the actual broken bones being steadied by an assistant. It is claimed for this mode of treatment that callus forms more rapidly, so that in a few days there is sufficient firmness to maintain the correct position; that pain is at once relieved, and with it the spasm of muscles which for the first few days after the accident tends to produce displacement; and that recovery is more rapid, all wasting, œdema, and stiffness being avoided. There is no doubt that some of these claims are justified, but in practice it is difficult to keep the bones in proper position whilst union is taking place, and the treatment requires a degree of skilled supervision which is not easy to obtain. It moreover requires the intelligent co-operation of the patient, and is inapplicable in the case of children and the timid. There is, in addition, the risk that, the muscles having been kept up to, and even above, their normal standard of strength, and pain being absent, the patient will be tempted to throw strain upon the bone too soon, so that cases of refracture are not uncommon.

(b) Absolute fixation, in plaster of Paris or some other convenient form of rigid apparatus, is maintained for a few days until muscular spasm has passed off, and the risk of fresh displacement minimized. Then daily massage, combined with both active and passive movements, is commenced. In the intervals,

the limb is immobilized by being replaced in the splints. This is continued for from four to six weeks, varying with the particular bone concerned, until union is sufficiently firm to allow of the splints being finally abandoned.

Whilst the results obtained from (a) are undoubtedly far better than the results of prolonged immobilization, it is doubtful whether they are superior to those obtained by a combination of fixation and massage. This has been amply demonstrated in a large series of cases at St. Thomas's Hospital, treated by J. B. Menell.

### *The Ambulatory Treatment of Fractures*

By this is meant that in fractures of the lower limb a rigid splint, such as that provided by plaster of Paris or some special form of instrument, is applied, and the patient is encouraged to walk upon the limb from the first. It is claimed that the time spent in hospital and the time of absence from business are shortened; that union is earlier and firmer; that prolonged œdema, wasting, and stiffness do not occur, and that complications such as hypostatic pneumonia and delirium tremens are avoided.

Except for fracture of the neck of the femur in old persons, it is a form of treatment that has found few advocates in this country, and one that would require very definite proof of its superiority over other methods to recommend it for general or even occasional usage.

### III. COMPLICATIONS OF FRACTURES

Some complications are due to improper treatment; others are only indirectly consequent upon the injury; others, again, are brought about by the injury which produces the fracture, or by the damage done by the broken bone itself at the time of the accident.

With regard to the *first* class, it is only necessary to mention that splint-sores, gangrene, injuries to nerves from pressure, and the local pressure-paralysis of muscles known as Volkmann's contracture or ischæmic paralysis, are all to be avoided by proper attention to the details of padding and bandaging in the application of the splints.

Of the *second* class, the two commonest are traumatic delirium and hypostatic pneumonia.

1. *Traumatic delirium*, and *delirium tremens* the special privilege of the alcoholic, may be brought on by any injury, but particularly

by a fracture. Possibly the sudden cessation of the supply of alcohol is a not unimportant factor in its causation. It may come on a few hours after the accident, or be delayed for several days. There are generally some premonitory symptoms, of which sleeplessness is one of the most important. Refusal of food, tremor, a suspicious, irritable temperament, and hallucinations are common. This stage is followed by restlessness and outbreaks of violence, so that mechanical restraint may be required.

The *treatment* is to be directed towards (a) protection of the fracture by suitable splinting, (b) administration of a proper quantity of food, if necessary by means of the stomach tube, and (c) the inducement of sleep. For this purpose large doses of chloral hydrate and potassium bromide (30 grains of each) are commonly given, and often without the least effect. Sometimes a subcutaneous injection of hyoscine hydrobromide (gr.  $\frac{1}{200}$ th to  $\frac{1}{100}$ th) answers very well, but often the best hypnotic will be found to be an ounce of brandy, whisky, or gin, according to the taste of the patient, given in hot water. It is unwise to withhold alcohol altogether.

2. *Hypostatic pneumonia* is very likely to attack old persons who are the subjects of fracture, even if they are kept in the recumbent position for only a few days. This complication is not infrequently fatal, so that the broken bone must often be considered of secondary importance, and the patient allowed to sit up out of bed on the second or third day, the fracture being controlled as well as possible by means of suitable splints.

In the *third* class are included complications which depend upon the proximity of important structures, and, in the case of compound fractures, upon the presence of infection.

In fractures of the skull, spine, chest, and pelvis, the damage that may happen to the important structures which those bones protect overshadows the bony injury, and is therefore dealt with separately under injuries of those regions.

The following local complications of fractures of the limbs sometimes occur, but, with the exception of injuries of the joints, they are not common.

1. *Injuries of blood-vessels.* Cases are on record in which the main artery of a limb is either torn, or obliterated by thrombosis. Laceration of a large artery is attended by the symptoms of subcutaneous rupture of an artery (p. 28). Such an accident is likely to be followed by gangrene.

Injuries of the large veins are rare, but damage followed

by thrombosis in the smaller veins is common, and is probably a cause of the persistent œdema which sometimes follows fractures of the lower limb. Nothing can be done for this condition except elevation and massage persisted in until such time as the collateral circulation shall have become established.

2. *Injuries of nerves* Nerves may be injured at the time of the accident either by the broken bone itself, or, independently of the fracture, by the force which has produced it. For example, we have seen a case in which the lower cord of the brachial plexus was injured by a depressed fragment of a comminuted clavicle. But most cases of plexus injury accompanying fracture of the clavicle are due to the violent stretching of the nerve trunks, when, in a fall upon the shoulder, the head and shoulder are forcibly separated. Again, the nerves may be injured some time after the accident, by involvement in callus.

The commonest peripheral nerve injury complicating fracture is that of the musculo-spiral in fracture of the humeral shaft. In injuries about the elbow the ulnar nerve is sometimes damaged, and the peroneal nerve may suffer in fracture of the neck of the fibula. It should be borne in mind that this nerve is occasionally injured, in fractures of the leg, neither by the accident itself nor by involvement in callus, but by faulty splinting exerting pressure upon it as it winds round the neck of the fibula. The diagnosis and treatment of nerve injuries is dealt with in Chapter XVIII.

3. *Injuries of joints.* Injuries of joints complicating fractures in their neighbourhood may take the form of :—

(i) Complete dislocation, as in a subcoracoid dislocation complicating fracture of the humeral neck.

(ii) Partial dislocation, as in a Pott's fracture.

(iii) Separation of a fragment of one of the bones entering into the joint, as of the internal condyle of the humerus.

(iv) Fissured fracture running into the joint, with but slight displacement, as in the T-shaped fracture of the lower end of the humerus.

(v) Sprains (see p. 148) of a joint in the neighbourhood of a fracture which does not actually involve the joint.

In all these cases the X-rays give invaluable assistance, and this examination should never be neglected. Whenever a fracture involves the articular cartilage, the most accurate reposition is required in order that the movements shall not be interfered with either by irregularity of the joint surfaces, or by the formation of excessive callus about the articulation. If there is any

difficulty about reduction by manipulation, an open operation will be required.

Whenever a joint has been injured, it is of special importance to begin massage and movements, both active and passive, at the earliest possible date, in order to avoid subsequent stiffness from adhesions.

#### IV. INDIVIDUAL FRACTURES

It is not possible to deal here with individual fractures in great detail, nor even to mention the less common varieties. Nor is it possible to describe or discuss the relative merits of various forms of splints. Equally good results can be obtained in many different ways, and with a variety of apparatus, but for the details of these the larger text-books must be consulted. Good results depend upon the care and assiduity with which the treatment is carried out far more than upon the particular form of splint employed.

##### A. FRACTURES OF THE SKULL

The chief interest of fractures of the vault and base of the skull lies in the accompanying injuries to the nervous system. They are therefore dealt with in Chapter XVIII. Other fractures of the skull are :—

1. *Nasal bones and cartilages.* Such fractures are often compound, either externally or into the nasal cavity. In the latter case, owing to the difficulty of securing asepsis, necrosis is not uncommon. The accident is readily recognized by the deformity, flattening being usually the most conspicuous feature. Hæmorrhage may be very severe, and sometimes subcutaneous emphysema occurs. It is highly important that the fragments should be replaced as early as possible, because union occurs very rapidly, and reduction may be very difficult even after a very few days. For this purpose a general anæsthetic is advisable, as the adjustment is a painful process and can be carried out more accurately when the patient is anæsthetized. Manipulation with the fingers, assisted by some form of blunt elevator, and a pair of forceps for straightening the septum, should that have been involved, will readily succeed in restoring the parts to their normal position. Once the deformity is corrected, it does not tend to recur. Splints introduced into the nose are painful, are apt to become very foul, and are best avoided. If they should be found necessary, one of the best patterns is that of Asch



(Fig. 20). They should be changed every forty-eight hours, and the nose should be frequently syringed with some mild antiseptic lotion.

2. *Malar bone.* Fracture of this bone generally occurs from severe direct violence, and the fragment may be depressed. There is often much bruising, and an external wound. The chief feature is the deformity, which is to be corrected by elevation of the depressed fragment. If there is an external wound, it may be taken advantage of; if not, an attempt should be made to lever the fragment into position through an incision in the mucous membrane at the point where it is reflected from the cheek on to the upper jaw, similar to that used for draining the maxillary antrum.

3. *Upper jaw.* These fractures are best treated by wiring the fragments together, either through holes drilled above the tooth sockets, or by an interdental splint. It is important that



FIG. 20. Asch's nasal splint.

the proper alignment of the teeth should be maintained, and disinfection of the mouth and nose should be carried out as thoroughly as possible.

4. *Mandible.* The common fracture is an oblique one, passing through the body of the jaw at the level of the incisor or canine teeth. It may be unilateral or bilateral, and, owing to the close attachment of the gum, is usually compound into the mouth. In consequence, some necrosis may occur and union may be delayed. Cases have been recorded in which a displaced tooth has become so entangled between the fragments as to prevent bony union. It is highly important to secure the proper alignment of the teeth, and the best results are obtained by means of an interdental splint, for which the services of a dentist are required. Whilst the bone is uniting, every effort should be made to maintain cleanliness of the mouth by frequent rinsing with some mild antiseptic lotion, especially after feeding. It may be necessary for the first few days to resort to nasal feeding. Usually, however, fluids can easily be given by means of a feeder, to the spout of which is attached a piece of rubber tubing

### B. FRACTURE OF THE HYOID BONE

This rare injury may be occasioned by direct blows, or by pressure as in throttling. It gives rise to much pain and difficulty in swallowing and speaking, but the chief danger lies in the dyspnœa which may arise from hæmorrhage, spasm, displacement, œdema, or even from surgical emphysema. When the dyspnœa is urgent, tracheotomy is required ; but usually all that is necessary is complete rest in the recumbent position, with an ice-bag or Leiter's leaden coil to the front of the neck, together with nasal feeding for a few days. It must be remembered, however, that at any time, tracheotomy may become urgently necessary, and that therefore the instruments should be kept at hand. These injuries are attended with a high rate of mortality, amounting, according to Erichsen, to nearly 80 per cent. Similar complications also occur from the even rarer events of fracture involving the thyroid, cricoid, and tracheal cartilages.

When the broken fragments of the hyoid bone pierce the mucous membrane, it is the pharynx which is wounded, and the chief danger is from sepsis. In the case of the laryngeal and tracheal cartilages the chief dangers are those of hæmorrhage into the air passages and œdema of the larynx. Should these injuries be encountered, it would probably be wise in most cases to perform tracheotomy at once.

### C. FRACTURES OF THE SPINE

These fractures are chiefly of importance in connexion with the injuries of the spinal cord and nerves that are so commonly associated with them. (See Chapter XVIII.)

The violence necessary to produce a fracture of the vertebral column is considerable. It may be direct, as from severe blows upon the back or from falls, but more commonly it takes the form of indirect violence brought about by forcible flexion or extension. Apart from concomitant injury of the nervous system, these injuries are not dangerous to life, but permanent deformity, or long-standing stiffness and pain may result. Occasionally a spinous process is broken off, or the fracture may pass through a lamina or a transverse process. These accidents, although unaccompanied by symptoms of nerve lesion at the time, may be followed later by signs of pressure upon the cord from the formation of a traumatic cyst, or of involvement of nerve roots in callus. For the slighter cases of fracture without nervous

lesion, no special treatment is required beyond rest and early massage, but the possibility of late nervous complications should be borne in mind, and a guarded prognosis must always be given.

#### D. FRACTURES OF THE THORAX

The ribs and sternum may be broken either by crushes of the chest, or by blows and falls. Here, again, the principal interest attaches to the presence or absence of intrathoracic or intra-abdominal complications, which are dealt with in Chapter XI and Chapter XV respectively.

#### E. FRACTURES OF THE PELVIS

'Buffer' accidents and falls from a height are responsible for most of the cases of fracture of the pelvis. The breaking off of small portions of the bone is uncommon and comparatively unimportant. Fracture of the rim of the acetabulum is a more serious injury, and is usually associated with dislocation of the femur. When the pelvis is fractured from being run over by a heavy cart, or from being crushed between buffers, the part most commonly implicated is the region of the symphysis, the fracture passing through the rami of the pubic bone, either on one or both sides. Such fractures are liable to extensive comminution; they are very frequently complicated by damage to the urethra or bladder and are, in addition, often compound. The diagnosis is made by careful palpation of the bony points, and an obscure fracture may sometimes be detected by pressing the iliac crests together, when mobility or localized pain may be detected. A rectal examination should always be made, in order to detect any irregularity of the pelvic wall. The diagnosis of the more common fractures of the pubic region is usually easy, the gap between the fragments being readily palpable. The treatment consists in placing the patient flat upon the back upon a firm mattress, and keeping the fragments in position by means of a plaster of Paris casing. If the displacement is considerable, and cannot be controlled easily by these means, the question of an operation for wiring the fragments together must be considered.

In treating fractures of this class in a private house, one of the chief difficulties arises from the unsuitability of the ordinary bed. It is essential to have a bed which will not sink in the middle,

and this may be ensured by placing what are termed 'fracture boards' beneath the mattress. A number of pieces of planking are required, just long enough to reach across the bed and to rest upon the frame on either side, so that the mattress, of whatever kind, cannot sink below the level of the framework.

The treatment of the visceral complications is discussed in Chapter XV.

## F. FRACTURES OF THE UPPER LIMB

### *Diagnosis of Injuries about the Shoulder*

These injuries often present great difficulty of diagnosis, especially in fat or muscular patients, and errors are best avoided by always making a systematic examination on some such lines as those suggested below. In this region in particular an X-ray examination is often invaluable.

(a) With the patient sitting upon a low stool, compare the two shoulders by *inspection* both from behind and in front, noting any difference in the position of rest of the limbs, any flattening of the deltoid, and any abnormal prominences or hollows. Generally speaking, if the elbow is held away from the side dislocation at the shoulder-joint is probable.

(b) Compare by *palpation* all the bony prominences of the sound side with those of the injured side, running the fingers along the spine of the scapula, the acromion process and clavicle, and feeling for the great tuberosity and coracoid process.

(c) Test the *movements* at the shoulder-joint, both actively and passively, thereby ascertaining either limitation of the normal range of mobility, or the presence of abnormal mobility. With one hand upon the shoulder, and the other grasping the patient's elbow, it will readily be ascertained whether the humerus moves as a whole or not, so as to detect or eliminate an unimpacted fracture of that bone.

(d) *Measurement.* Compare the distance between the point of the shoulder (i.e. the angle which the spine of the scapula makes with the acromion process) and the external condyle of the humerus on the injured side with that on the sound side. It will be shortened in dislocations and in most fractures of the humerus, but lengthened in fracture through the neck of the scapula.

The following common fractures in this region may be briefly noted :—

1. *Clavicle.* The common fracture of the shaft is conveniently  
s. & r.

treated by the classical method of Sayre (Figs. 21 a and 21 b), but some deformity is apt to persist. If the patient will submit to the restraint, a better result can be obtained by placing him flat upon the back in bed upon a firm mattress, with the forearm supported in a sling, and a small pillow between the shoulders. Operative



FIG. 21 a. Sayre's strapping : front view.

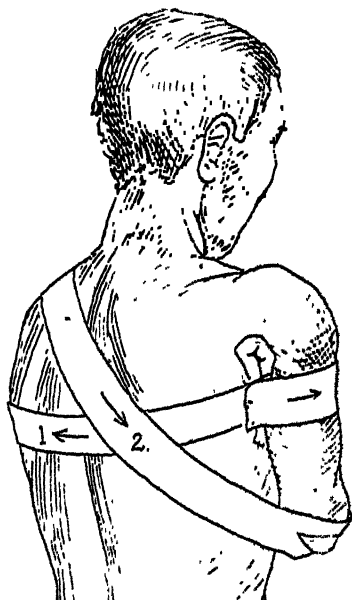


FIG. 21 b. Sayre's strapping : back view.

A pad is placed in the axilla. Two broad pieces of strapping are required. No. 1 is pinned round the arm and passes round the back, so as to brace the shoulder well backwards. No. 2 brings the elbow forwards, and so throws the outer end of the clavicle backwards, outwards, and upwards, the attachment of No. 1 to the arm acting as a fulcrum.

measures are rarely called for, but may become imperative if a displaced fragment is pressing upon the subjacent vessels or nerves.

2. *Scapula.* Fracture of the acromion process may be conveniently treated by Sayre's method.

In fracture of the body of the scapula there is usually no displacement, so that splinting is not necessary. The arm should be supported in a sling, and massage carried out from the beginning.

Fracture of the neck of the scapula is not a common accident, but must be borne in mind lest it should be mistaken for a dislocation on account of the flattening of the deltoid. Here, how-

ever, the arm is not held away from the side, the limb is lengthened, and the deformity is readily reduced by pushing the humerus upward; and, so far from there being limitation of movement such as is characteristic of dislocation, there is abnormal mobility accompanied by crepitus. Treatment by Sayre's method answers well, but massage and movements of the shoulder-joint should be begun early and carried out systematically in order to prevent stiffness.

3. *Humerus. Upper end.* Fracture of the *surgical neck*, that is to say of that part of the shaft immediately below the tuberosities, closely resembles a fracture through the epiphyseal cartilage, (separation of the epiphysis), and it may be difficult to distinguish the two without the aid of a skiagram. The ordinary uncomplicated fracture of the surgical neck is most conveniently treated by Strohmeyer's cushion, combined with a moulded shoulder-cap of gutta-percha. Fracture of the surgical neck may be associated with dislocation of the head of the bone from the glenoid cavity, in which case an open reduction combined with wiring or plating of the fragments would give the best result.

*Separation of the upper epiphysis* of the humerus may be suspected if the patient is between the ages of 10 and 20. It is particularly important to recognize this injury lest imperfect reposition should interfere with the subsequent growth of the bone. If there is any difficulty in reduction, or in keeping the fragments together after reduction, there should be no hesitation in doing an open operation.

*Fracture of the anatomical neck* is a rare accident, and one which is difficult of diagnosis except by the help of the X-rays. If impacted, it should be treated by daily massage and movements of the joint from the very beginning. If not impacted, a stiff shoulder is almost certain to result unless an open operation is done, and the displaced head either fixed in position or removed. If operation is performed, massage must be begun not later than the end of the first week, merely allowing time for the wound to heal.

*Shaft.* Fracture of the humeral shaft is sometimes followed by failure of union, and is occasionally complicated by injury to the musculo-spiral nerve either at the time of the accident or subsequently by involvement in callus. It can be treated conveniently by a plaster of Paris splint, one half being adapted as an internal angular splint so as to fix the elbow-joint, and the other as an external angular splint, reaching to the wrist, and having at its upper end an expansion to act as a shoulder-cap. Other

forms of splint are equally efficacious. A useful variety is Hoppe's adjustable aluminium splint, which is readily adapted for the treatment of this as well as many other forms of fracture of the arm and forearm. It has the advantage of being sufficiently transparent to the X-rays to allow of the bone being examined with the splint in position.

### *Diagnosis of Injuries about the Elbow*

(a) The two elbows must first be compared by *inspection*, any differences being noted, and the position in which the patient holds the forearm being observed. In backward dislocation of both bones of the forearm, and in transverse fracture above the condyles with backward displacement, abnormal projection will be noted behind, and in front a prominence will be seen, usually with a very sharp indentation immediately below it.

(b) *Palpation* of the bony points must next be carried out, and their relations to one another compared with those of the corresponding points of the opposite side. Normally, when the elbow is almost fully extended, the two condyles and the tip of the olecranon process lie in the same straight line, but in flexion the lines joining those points form a triangle with its apex downwards, at the tip of the olecranon. These relations are unaltered in supracondylar fracture, but altered in dislocation and in fracture of the olecranon.

(c) The *movements* obtainable will give valuable information. In dislocations, immobility is the rule; in fractures, abnormal mobility, accompanied by crepitus.

A fracture of the olecranon is readily recognized by feeling the loose fragment, with a gap separating it from the rest of the ulna. Fractures of the condyles can be detected by grasping those processes between the finger and thumb, and feeling them move upon the rest of the humerus, perhaps with crepitus.

If the only obvious sign is limitation of pronation and supination, the possibility of fracture about the upper end of the radius, or else the peculiar injury produced by forcible dragging upon the hands of children, known as subluxation of the radius ('pulled elbow'), should be borne in mind (see p. 154).

(d) The importance of the *X-rays*, in establishing the actual lesion in these injuries about the elbow, cannot be over-estimated.

The following common fractures in this region may be noted :

1. *Olecranon*. If the separation is trivial, the only treatment

required is rest upon an internal angular splint, and daily massage and movements of the elbow-joint.

When an interval of a quarter of an inch or more exists, the fragment should be wired in position, unless operation is contra-indicated on account of the patient's general condition, because it is only by this means that firm bony union can be secured and the full strength of the arm restored.

*Operation.* An incision some three inches in length is made in the long axis of the limb, with its centre over the fracture. The interval between the fragments is exposed thoroughly, and any intervening shreds of fibrous tissue, and blood-clot, removed with a blunt spoon. The bones are next drilled on either side of the fracture, the instrument entering about half an inch from the edge of the gap, and emerging upon the face of the fractured surface, just short of the articular cartilage. The wire, preferably of silvered copper, is then passed and made to secure the fragment of bone accurately and firmly in its natural position. The wound is then closed. No splint is required, and gentle movements should be begun in two or three days.

2. *Transverse supracondylar fracture*, separation of the lower epiphysis, and the T and Y-shaped fractures into the joint, may be taken together as the treatment is similar. Separation of the epiphysis may be suspected if the patient is under 17 years of age, and if the anterior projection above the fold of the elbow is smooth and rounded rather than sharp, but the diagnosis can only be made with certainty by an X-ray examination.

The tendency in these cases is for the lower fragment, carrying the forearm, to remain displaced backwards, forming an angle with the shaft which projects forwards and interferes with flexion. Attempts may be made to overcome this tendency by putting up the limb in a splint with the forearm acutely flexed, but if this is done the greatest care should be taken that the circulation in the limb below the elbow is not interfered with. The reduction of the deformity is more easily effected if carried out under an anæsthetic, and careful X-ray examinations should be made from time to time. Not more than a week should elapse before the splint is taken off to allow of movements of the elbow-joint. Such movements should be carried out daily, and always with great gentleness. Robert Jones believes that too early and too energetic passive movement in these cases is 'positively harmful; it disturbs the uniting fragments and leads to fresh plastic effusion, excess of callus, and increased formation of connective tissue about the joint, all of which are conducive to



increased stiffness'.<sup>1</sup> The splint may be discarded in a week or ten days, the elbow being then kept flexed and at rest by means of a sling; the degree of flexion is gradually allowed to approximate to a right angle as recovery proceeds.

Fracture of the *shaft of the forearm bones*. The radius and ulna may be fractured at any point, and either separately or together. In most cases the forearm should be put up in the mid-prone position between two wooden splints. Plaster of Paris should not be used, because of the tendency of a sheath splint to approximate the bones instead of keeping them apart and parallel



FIG. 22. Reduction of Colles's fracture. First step.

with one another. If the radius is broken above the insertion of the pronator teres, that is, roughly, above its middle, the semi-prone position ought not to be adopted, but the forearm should be put up fully supinated upon an anterior angular splint. The reason for this is that the upper fragment, being fully supinated by the biceps, must have the lower fragment brought into apposition with it in a fully supinated position. If this were not done, the bone would unite with its upper part supinated and its lower part only half supinated, with the result that the power of full supination of the hand would be lost.

*Colles's fracture*. In this injury, which is produced by a fall upon the outstretched hand, the lowermost portion of the radius is separated by an oblique fracture from the rest of the bone,

<sup>1</sup> *Proc. Roy. Soc. Med.*, Dec. 1910.

and displaced upwards, backwards, and outwards, carrying the hand with it. At the same time the internal lateral ligament of the wrist-joint is ruptured, or the styloid process of the ulna is torn off. Thus the hand is held in a position of abduction, whilst the lower end of the radius forms a prominence upon the back of the wrist. In the treatment, the main points to remember are (a) that the deformity, being produced solely by the force which produced the fracture, and not by muscular action, will rarely tend to recur when once it has been reduced, and (b) that there is always some damage to the tendon sheaths which pass



FIG. 23. Reduction of Colles's fracture. Second step.

over the back of the wrist. It is therefore unnecessary in most cases to use splints, and especially necessary to enjoin movements of the fingers from the very first, in order to prevent stiffness. If the fracture is impacted, an anaesthetic should be given, the bones freed from one another, and the fracture then treated exactly as though it had not been impacted at the outset. A convenient method of reduction is shown in Figs. 22 and 23.

After reduction has been effected, a small pad should be placed on the dorsum, and another on the palmar aspect, of the wrist, and secured firmly in place with strapping. The hand should be carried in a sling, and the fingers constantly exercised. If, as occasionally happens, the deformity does tend to recur,

a Carr's splint should be applied, with a short straight splint along the dorsum.

*Fractures of the wrist.* The only carpal bone which is fractured with any degree of frequency is the scaphoid. The injury is produced by a fall upon the outstretched hand, and may be associated with a Colles's fracture, or with a fissured fracture of the lower end of the radius or of one of the other carpal bones. It is not uncommon as the result of the hand being struck by the starting-handle of a motor engine from back-firing. There is often no displacement, and possibly the injury will be regarded only as a sprain until the persistence of the pain and disability suggest an X-ray examination. The treatment consists of massage and gentle movements. Robert Jones has pointed out that the usual disability following this fracture results from the loss of power of extension of the wrist. He recommends that the wrist should be kept in a position of hyper-extension for a fortnight.

*Fracture of the metacarpal bones.* The only special point of importance to remember is that when the shafts of these bones are broken, the hand should be put upon a splint with a firm palmar pad, in order to preserve the natural arch of the bone with its palmar concavity.

## G. FRACTURES OF THE LOWER LIMB

### *Diagnosis of Injuries about the Hip*

A systematic examination on the following lines will usually enable a correct diagnosis to be made, but whenever possible it should be confirmed by means of a skiagram. The association of a recent injury with either an old-standing deformity or pre-existent disease of the hip is a possibility which should always be borne in mind. Thus, the deformity produced by old-standing osteo-arthritis may simulate a fracture of the femoral neck; a fall upon the hip may merely call attention to a pre-existent condition of coxa vara; a patient with an ankylosed hip from old tuberculous disease may sustain an injury, and unless inquiry be made into the history, the previous deformity may be thought to be due to the recent injury. The following routine examination should be made,—

(a) Note the *position of the limb*. In most fractures of the femur the characteristic posture assumed when the patient is lying on the back is excessive eversion, so that the outer border of the foot lies upon the bed. In dislocations there is flexion at the hip, with

adduction and inversion in the backward displacements, abduction and eversion in the forward dislocations of the head of the femur.

(b) Ascertain by *palpation* with the two hands simultaneously whether there is any difference in the position or prominence of the corresponding bony points on the two sides. With the thumbs upon the anterior superior iliac spines, and the index fingers upon the tips of the great trochanters, any difference in the relative position of these two points can be roughly estimated. Deep pressure in the buttock behind the great trochanter sometimes enables the displaced head of the femur to be felt, whilst absence of the head from its normal position may be detected

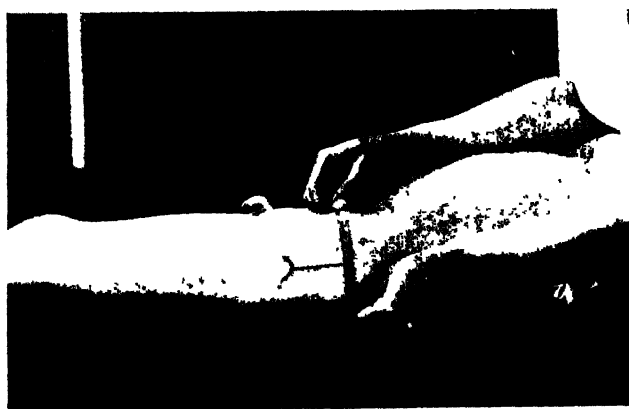


FIG. 24. Bryant's line.

by feeling a hollow instead of a bony prominence behind the femoral vessels.

(c) *Measurements.* The length of the two limbs should be compared in the ordinary manner by taking the measurements between the anterior superior iliac spine and internal malleolus on each side, care being exercised that the limbs are in corresponding positions as nearly as circumstances allow. For this purpose the uninjured limb must be placed in the same position as the injured one. The second measurement necessary is from the tip of the great trochanter to a vertical line dropped from the anterior superior spine. This is known as Bryant's line (Fig. 24). Shortening of this line shows elevation of the trochanter and points to a fracture of the femoral neck or a dislocation at the hip-joint.

(d) Test the *movements* at the joint. Immobility is characteristic of dislocation; abnormal mobility of fracture, but muscular

resistance often obscures this sign. No reliance is to be placed upon the presence or absence of crepitus, as this is absent in impacted fractures, is nearly always unobtainable in intracapsular fracture, and is often present in osteo-arthritis when there is no fracture.

The following are the more common fractures in this region :—

1. *Neck of femur.* The fracture which most often occurs in persons past middle life from slight indirect violence is usually situated near the head of the bone, and is known as 'intracapsular'. The classical signs of fracture are slight or absent, so that the injury may escape diagnosis unless a skiagram is taken. Moreover, it may be closely simulated, or accompanied, by osteo-arthritis. The usual signs are pain, limitation of movement, eversion, and slight shortening. Impaction is rare.

The *treatment* must be carried out with due regard to the general condition of the patient. These patients are often old, endure confinement to bed badly, and are liable to develop bed-sores and to suffer from pulmonary congestion. They should not be kept in bed for more than a few days, and during that time the limb must be kept at rest between sand-bags. When the pain has subsided the patient should be allowed to get about on crutches, the femur and hip-joint being supported by a moulded leather or poroplastic splint. Bony union is not to be expected unless the fracture should happen to be an impacted one.

The fracture of the femoral neck, known as 'extracapsular' in which the line of fracture passes through the broad part of the neck close to the great trochanter, occurs from greater violence and in younger subjects. If caused by a fall upon the hip, impaction of the head into the trochanters is likely to have occurred. The shortening and eversion are much more marked than in intracapsular fracture.

*Treatment.* When impacted, the fragments should be disengaged, in order to allow of proper reduction of the deformity; but if the deformity is slight, and the patient old or otherwise unsuited for an active life, the desirability of allowing union to occur in the position of impaction may be discussed. The case may be treated equally satisfactorily in a variety of different ways, the main points to attend to, whatever kind of splint may be used, being abduction and extension. One of the most satisfactory methods is the plaster of Paris 'breeches', combined with a weight-and-pulley extension (Fig. 25). This must be

applied under an anæsthetic, and a skiagram taken shortly afterwards to determine whether the position is satisfactory. If a good position cannot be obtained by manipulation, operative measures may be required.

2. *Separation of the upper femoral epiphysis.* This injury occasionally occurs in children and young people up to the age of 18 years; it is produced by comparatively slight violence, and frequently escapes notice until the disability and deformity from the resulting coxa vara calls attention to the nature of the injury. If seen immediately after the accident, the prominent symptoms are pain, some swelling, limitation of movement, shortening, and external rotation. The diagnosis from fracture of the neck, which is sometimes met with in early life, and from sprains, should be confirmed by means of an X-ray examination.

*Treatment.* The difficulty of controlling the detached epiphysis is so great that manipulative measures alone may fail to secure accurate reposition. An attempt, under anæsthesia, should be made, and the limb fixed in an abducted position in plaster of Paris. Skiagrams should again be taken, and if the position is unsatisfactory there should be no hesitation in recommending an open operation. This consists in opening the joint through an anterior incision, and securing the fragments in proper position by means of a screw driven through the trochanter along the neck into the detached epiphysis.

*Fracture of the shaft of the femur.* A fracture in the region of or immediately below the trochanters is likely to present great difficulty in treatment, because of the tendency of the short upper fragments to become tilted and to override the lower.

Good results may be obtained by putting the limb up, under an anæsthetic, in plaster of Paris with a pulley-and-weight extension, but this will often be found to fail, in which event some form of splint must be used which brings the lower fragment into line with the upper by elevation combined with

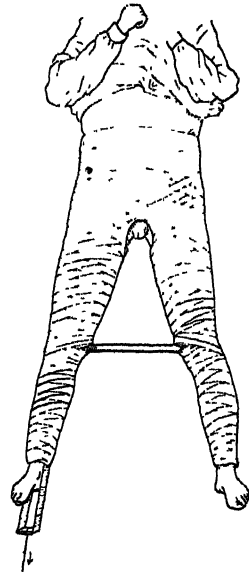


FIG. 25. Plaster of Paris breeches for fractured femur.

extension. The Hodgen splint (Fig. 26) answers this purpose admirably, but it has the disadvantage of being difficult to keep in place, and requires unremitting attention. If the ordinary plaster method fails, it is better to operate and secure the fragments in position by plating.

*Fracture of the femur in its middle two-fourths* requires no special mention. The ordinary plaster of Paris method rarely fails to give a good result, though sometimes a better position can be obtained by an open operation.

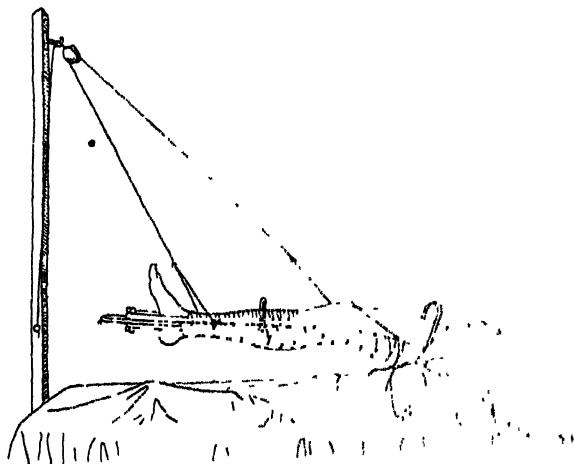


FIG. 26. Hodgen's splint.

*Supracondylar fracture* requires very special care in order to secure a good result. The lower fragment becomes rotated by the gastrocnemius in such a manner as to cause the broken surface to look towards the popliteal space, sometimes producing serious consequences from pressure upon the popliteal vessels. But more than this, it is possible to put the limb straight with the fragment still rotated. It is advisable therefore to treat this fracture with the knee flexed so as to take off the pull of the gastrocnemius. The Hodgen splint answers the purpose very well, but if this is not available a Macintyre splint flexed acutely can be made to answer the purpose. With proper care a good result can be obtained with plaster of Paris applied when the muscles are relaxed by anæsthesia, but if this method is employed it is essential to verify the position by a skiagram from the lateral aspect.

*Separation of the lower femoral epiphysis.* This accident may

occur up to about the age of 20. The epiphysis may be rotated in the same manner as the lower fragment in a supracondylar fracture, but more often the lower end of the upper fragment is displaced backwards. Reduction may be effected by flexing the knee to a right angle, and forcibly pulling the leg forwards and the thigh upwards. The limb may then be put up in the extended position in plaster of Paris. At the end of a week or ten days massage and movements should be begun in order to avoid stiffness of the knee, the limb in the intervals being replaced in the plaster case. Should the position obtained by manipulation prove unsatisfactory, reduction must be effected through an open incision, but wiring is neither necessary nor advisable, as the deformity will not tend to recur after the epiphysis has once been replaced.

Fractures of the femur which involve the knee-joint, and especially those in which the condyles are separated, require the most accurate apposition of the fragments in order to prevent subsequent interference with the mechanism of the joint. Early exercise and massage must be employed in order to prevent stiffness.

*Fracture of the patella.* Fissured fractures without separation of the fragments require no treatment beyond rest and massage. The ordinary transverse fracture, with separation and tilting of fragments and interposition of torn aponeurosis (Fig. 27), should always be operated upon unless there is some definite contraindication on general grounds. Without operation it is doubtful whether bony union can occur; at any rate it is exceedingly rare, and though firm fibrous union with close apposition of the fragments may be obtained by non-operative methods, the functional result is not likely to be satisfactory on account of the tendency of the uniting fibrous tissue to become stretched. Many surgeons prefer to wait for a week or ten days before operating, in order to allow time for the effusion into the joint to subside. This practice has little but tradition to recommend it, and better results are in our opinion obtained by immediate operation.

*Operation.* A vertical incision is made over the site of fracture, and the edges well retracted so as to obtain a good view of the fragments. With a blunt spoon the interposing fragments of torn aponeurosis are scraped from the fractured surfaces and cut away with scissors. The blood in the joint is removed either by strips of dry sterile gauze, or by irrigation with normal saline solution. The fragments are next drilled obliquely, the



instrument entering the anterior surface of the bone half an inch from the broken edge, and emerging upon the face of the fracture just in front of the articular cartilage (Fig. 28). The wire, preferably of silvered copper, which is less brittle than silver, is next passed, and the fragments accurately approximated. The twisted ends of the wire are now hammered down flush with the surface of the patella and the wound closed. No splint is required. At the end of a week massage and movements should be begun.

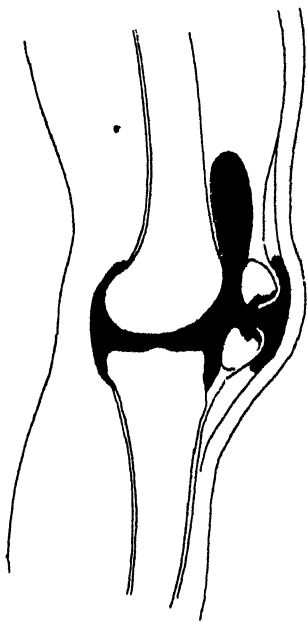


FIG. 27. Fracture of the patella, showing joint full of blood, tilting of fragments, and torn aponeurosis between the broken surfaces.

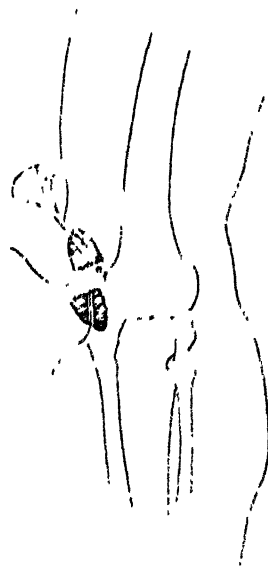


FIG. 28. Wiring a fractured patella.

*Fractures of the bones of the leg.* Fracture of the shaft of the tibia and fibula calls for no special description. The diagnosis is usually easy.

*Treatment.* The patient should be anesthetized and the deformity reduced by traction upon the foot, aided by manipulation at the site of the fracture. A plaster of Paris splint should be applied, which must enclose the foot and reach well above the knee. This should remain undisturbed for ten days, provided that an X-ray examination, made through the splint, shows the

bones to be in good position. At the end of that time the splint should be removed, and massage, combined with movements at the ankle and knee-joints, should be carried out daily, the limb in the intervals being either replaced in the plaster case or simply allowed to lie between sand-bags. In cases where a satisfactory position cannot be maintained by means of the plaster splint, operation may be undertaken.

*Pott's fracture.* The seriousness of this injury lies in the dislocation at the ankle-joint, the fracture being of secondary importance. The fibula is broken obliquely above the base of the malleolus, and either the internal lateral ligament of the ankle is ruptured or the internal malleolus is broken off. At the same time the foot is displaced outwards and backwards, and it is this displacement which, if left unreduced, gives rise to the severe disablement which follows some cases of Pott's fracture, namely, traumatic flat foot.

*Treatment.* In spite of the pessimistic statements of enthusiastic advocates of operation upon these injuries, there is no doubt that with sufficient care a perfect result can be obtained without operation in the great majority of cases. Bad results are due to bad 'setting', or to prolonged immobilization, not to any inherent peculiarity in this particular fracture. An anæsthetic must necessarily be given. Then, with the muscles completely relaxed, the dislocation is to be reduced by traction upon the foot assisted by manipulation with the fingers. The chief tendency after reduction is for a certain degree of eversion to recur, and this is to be avoided by putting the foot up in a distinctly inverted position. The plaster of Paris splint should extend from the toes to just above the knee, and should remain in position for a week. At the end of that time the splint must be removed and daily massage and movements of the ankle begun, the limb in the intervals being placed either between heavy sand-bags or in the plaster case, and relieved from the weight of the bed-clothes by a cradle. On the next day skiagrams should be taken, one antero-posterior and another lateral, so that the correction both of the backward and of the outward displacement can be determined. If the position is not absolutely correct, the limb must be again put up under an anæsthetic. It is only by perseverance that a perfect result can be attained.

*Fracture of the tarsal bones.* The only bones of the tarsus which are fractured with any degree of frequency are the astragalus and os calcis. Such injuries are difficult to diagnose without the aid of the X-rays, an examination which should always be made as a routine measure. No rules as to treatment can be laid

down, except in a general way, because the diversity is so great that each case must be treated upon its own merits. Generally speaking, the best method is to restore the contour of the foot as far as possible, under an anæsthetic, taking great care that the arches are restored completely, and then to immobilize it in plaster of Paris. This should remain in place for a week or ten days, when massage should be begun. If there is much comminution of the bones it is sometimes advisable to remove some of the fragments through an open incision, as the tendency to permanent limitation of movement in these cases is considerable.

*Crushes of the foot.* These very common accidents, usually compound and attended with comminution of the metatarsal bones and phalanges, sometimes necessitate immediate amputation, but as a rule it is better not to perform either of the formal amputations, but to remove only such portions as appear to be hopelessly damaged.

*Operation.* The whole foot should first be thoroughly cleansed as described in Chapter IV. The most severely damaged parts are then to be cut away, all the skin which appears at all likely to live being preserved. After arresting the hæmorrhage a few sutures should be inserted loosely, so as to avoid all tension, and the wound covered with a voluminous dressing. From the next day onward the foot should be immersed for several hours at a time in a boracic bath, and wrapped in dry dressings in the intervals. In this manner it is often possible to preserve large portions of a foot which at first sight would appear to require amputation.

## V. PATHOLOGICAL FRACTURES

Pathological or 'spontaneous' fractures are those produced in a bone which is the subject of some pathological change, by a degree of violence which would be insufficient to break the normal bone. Sometimes the force is quite trivial, such as some ordinary muscular action or a false step. The abnormal fragility of the bone may be due to its insidious destruction by a malignant growth, either primary or secondary; to progressive rarefying osteitis in tabes dorsalis and syringomyelia; and more rarely to the development of a hydatid cyst within the bone. Tuberculous and syphilitic disease are also rare causes. These cases may constitute a very real emergency, for the sudden appearance of a gross deformity with loss of power and loss of function in a limb may present a very puzzling picture.

*Diagnosis.* Absence of pain is a most striking feature, and

the deformity is usually extreme. The presence of a tumour may have remained unsuspected until the fracture has occurred, so that the history does not always give assistance. A history of some previous operation for the removal of a tumour, particularly of the breast, would indicate the probable cause of a fracture from slight violence, whilst the neuropathic cases would be recognized by the symptoms of the disease which they complicate.

*Treatment.* Beyond support upon a suitable splint nothing can be done for the cases due to secondary malignant growths. In primary tumours and tuberculous disease amputation is required. In the rare instances due to syphilis, antiluetic treatment, followed by operation if union fails to occur, would be the right line to adopt. For the neuropathic cases the ordinary treatment for that particular fracture is required, and there is no evidence that union is less satisfactory in these instances than in ordinary cases, except that it may be somewhat delayed.

## CHAPTER VIII

### INJURIES AND DISEASES OF JOINTS

ANY or all of the structures entering into the formation of a joint may be involved in an injury in its immediate neighbourhood, namely, bones, cartilages, synovial membrane, ligaments, tendons, nerves, blood-vessels and any other structures in close relationship with it. It behoves the practitioner brought face to face with such an accident to make a most careful examination for each possible variety of injury, for the ultimate functional use of the joint depends very much upon the initial treatment adopted. Injuries accompanied by external wound are accompanied by the additional risk of septic infection.

#### A. WOUNDS OF JOINTS

Accidental wounds in which the joint is actually penetrated or opened into are very likely to cause acute septic arthritis; in some instances, which fortunately are now very rare, a joint which has been opened during some deliberate surgical procedure becomes infected. The course and treatment are the same in each, and in each the outlook is grave, both as regards the ultimate utility of the joint and the constitutional complications.

All cases of accidental wounds to joints should be regarded in a serious light, and a very guarded prognosis should always be given.

*Penetrating wounds of joints.* When a patient has sustained a penetrating wound of a joint only a short time before he is seen, the following line of treatment should be carried out: the wound and surrounding skin are to be thoroughly cleansed, an antiseptic dressing applied, and the limb placed upon a splint. No probing must be done, as little information is likely to be derived from such examination whilst much harm may result. A careful watch must be kept upon both the local and general condition. If there is much pain with effusion into the joint, and the temperature rises up to or beyond 101° F., the joint should be opened, and, cultures having been taken from the exudate, it should be thoroughly washed out with sterile saline solution and closed without drainage. By this means, even though pyogenic

organisms may be found in the fluid, the disease can sometimes be arrested and recovery with normal movement secured. If, however, the symptoms show no improvement, the stitches should be removed and a drainage tube inserted (Fig. 29). The knowledge of the bacteriology of the fluid will enable the appropriate antitoxin or vaccine to be used.

In cases which, when first seen, are too advanced for a trial of the treatment by lavage, or which progress in spite of it, continuous irrigation may be employed. As the knee is the joint by far the most frequently affected, the following description

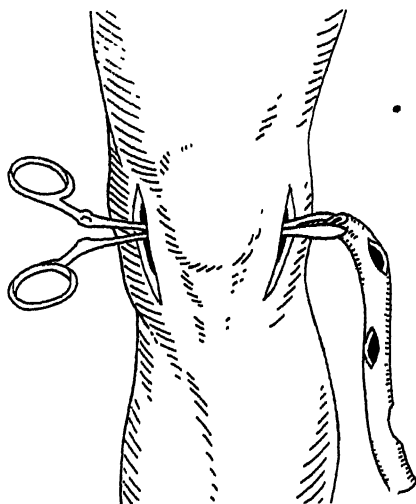


FIG. 29. Drainage of the knee-joint.

will apply to it, but can be modified to suit other joints. An incision, from three to four inches long, is made on either side of the patella, and a piece of wide drainage tube, which should only just project into the joint, secured into each incision by means of a stitch. The limb, slightly flexed upon a macintosh-covered splint, is suspended over a large leg-bath; one of the drainage tubes is then connected with a mixing tap, with or without the intermediation of a filter, in such a manner that a rapid stream of water, kept constantly at a temperature of 105° F., can flow into the joint, out of the opposite tube and into the bath. This treatment can be kept up continuously for two or three days if necessary. Needless to say, it requires the undivided attention of a special nurse.

Should this treatment be unavailing, the two lateral incisions

may be joined by another one passing through the ligamentum patellæ, and the flap so formed turned upwards. The knee is then flexed to a right angle and the whole synovial cavity lightly packed with gauze, which is to be changed frequently. After a few days, if the constitutional symptoms are abating and the local condition improving, the limb may be gradually straightened and the flap turned down and secured in place with a few sutures. If the ankylosis which must ensue takes place in a flexed position, subsequent operation will be required to correct the deformity.

If, in spite of all treatment, the suppuration cannot be arrested, and the constitutional symptoms increase in severity, and especially if symptoms of pyæmia appear, amputation must be performed.

### B. SPRAINS

A sprain is the injury brought about by a sudden severe wrench which does not produce a fracture or dislocation. There is laceration of the various structures composing and surrounding the joint, namely, small blood-vessels, ligaments, the synovial membrane of the joint itself, and often also of surrounding tendon sheaths. In sprains of the wrist and ankle there may be displacement of one or more tendons from their grooves. The diagnosis of a sprain rests upon the history of injury and the absence of dislocation or fracture. The accident is followed by more or less effusion of fluid into the joint and tendon sheaths, and hæmorrhage into the subcutaneous tissues.

*Treatment.* The joint is to be placed at rest upon a pillow, and an ice-bag applied, or an evaporating lotion dressing, but cold must be employed cautiously in the case of old people and children. The skin must not be allowed to become so sodden as to interfere with massage, which should be begun after two or three days. Many advocate the immediate commencement of massage as promoting absorption and easing the pain. Daily massage for ten minutes at first, but gradually increased up to twenty minutes or half an hour, together with movements of the joint, both active and passive, will promote absorption of effusion, prevent pain and stiffness, and at the same time keep up the nutrition of the muscles.

### C. INTERNAL DERANGEMENTS

These injuries include displacement of inter-articular cartilages, inclusion of enlarged synovial fringes between the joint surfaces, and the 'locking' of joints due to loose bodies. The history in all

these cases is similar. There is sudden acute pain, accompanied by inability to move the joint, which, in the lower limb, usually results in throwing the patient to the ground. This is followed by effusion of fluid into the joint. If seen immediately it will be found that the movements are limited, any attempt to bring about the full range of movement being accompanied by great pain. Such accidents are far more frequent in the knee than in any other joint.

*Treatment.* The first thing is to disengage the displaced cartilage or other body from between the articular cartilages. In the case of the knee this is done by slowly and steadily flexing the joint as far as possible, and then suddenly extending it. Patients in whom this accident often happens can 'put the knee in' for themselves, by bending the leg and then suddenly kicking. After the replacement the joint should be kept at rest upon a pillow for two or three days, according to the severity of the synovitis which results. After that time, massage should be employed. The loose body or displaced cartilage will probably require removal later.

#### D. DISLOCATIONS

Dislocations are complete if no parts of the articular surfaces normally in contact are touching one another; incomplete if those surfaces are anywhere in contact. Incomplete dislocations are also known as subluxations. In every dislocation some damage must be done to the structures surrounding the joint, such as laceration of the capsule and ligaments, and displacement or rupture of tendons. In addition, there may be more serious complications, such as the breaking off of small portions of bone entering into the articulation, and damage to nerves or blood-vessels.

Dislocations, like fractures, are *simple* or *compound*. The latter are not common, but are very serious accidents as regards the future utility of the limb. The chief dangers are those of sepsis, but if infection can be prevented the course is the same as that of a simple dislocation. The methods of dealing with the wound in compound dislocations are the same as those described under Compound Fractures.

*Complications.* As already stated, all dislocations are necessarily accompanied by a certain amount of damage to surrounding structures, just as all fractures with displacement are necessarily accompanied by laceration of the periosteum and muscle in the



immediate neighbourhood. The possibility of certain other occasional complications must be borne in mind.

(a) Amongst the more important are injuries to *nerves*. Nerves may be damaged independently by the same accident as that which causes the dislocation, or by the displaced bone. Thus the brachial plexus may be lacerated, and the shoulder dislocated independently by a common injury, or it may be damaged by the displacement of the humerus itself. In dislocation of the elbow the median or ulnar nerves may be injured, and in dislocation of the hip the anterior crural or sciatic nerves may suffer. As a rule the injury takes the form either of a functional interference with the conductivity of the nerve, or of a partial laceration within its sheath, both of which conditions would be followed, in time, by recovery. In dealing with a dislocated shoulder, the possibility of injury to the circumflex nerve should never be lost sight of, because, although the displacement may have been reduced and the flattening of the shoulder thereby remedied, a secondary flattening due to atrophy of the deltoid may appear subsequently, together with a certain degree of dropping away of the humerus from the glenoid cavity. This may raise doubts as to whether the dislocation was properly dealt with in the first instance, and the patient should therefore always be warned of its possibility.

(b) Injuries to *blood-vessels*. Main vessels may be pressed upon by a displaced bone so as to cause a transient oedema or a loss of pulse in the artery beyond; they may be so damaged as to cause thrombosis after the dislocation has been reduced; or they may be actually ruptured either at the time of the accident or during the manipulations necessary for reduction. These complications are met with most frequently in the case of the shoulder (the displacements of which constitute more than 50 per cent of all dislocations), because of the close proximity of the axillary vessels to the head of the humerus. Laceration of the axillary artery or of one of its branches will be rapidly followed by the appearance of a tense, increasing, and perhaps pulsating swelling, a condition which demands instant operation (see p. 28).

(c) Other occasional complications occur in special regions, such as fracture of the acetabular rim in dislocations of the hip, pressure upon the trachea in displacement of the sternal end of the clavicle, and injuries to the spinal cord and nerve roots in dislocations of the vertebræ.

## DIAGNOSIS AND TREATMENT OF DISLOCATIONS IN GENERAL

The outstanding features in all dislocations are immobility, deformity, and alteration of the normal axis of a bone. These signs can be recognized at once, and if, on examination, any movement is obtained, or any suspicion of crepitus raised, a skiagram should be taken so as to ascertain the presence or absence of concomitant fracture. In the case of the limbs, the condition of the circulation beyond the injured joint should be investigated as a matter of routine, and the sensation in the area of distribution of any nerve whose relation to the joint renders it liable to injury should be tested.

*Treatment.* The chief obstacle to reduction is muscular spasm, and this can readily be abolished by an anæsthetic. It is not always necessary to give an anæsthetic, but its employment, besides obviating pain, renders reduction easier and so diminishes the liability of increasing the damage to surrounding structures. In special regions other factors may participate in rendering reduction difficult. Thus an inter-articular fibro-cartilage may be so entangled as to prevent replacement, as in the case of the metacarpo-phalangeal joint of the thumb; and fracture of the rim of the acetabulum may interfere with the ordinary course of reducing a dislocation of the hip.

The muscles being relaxed by anæsthesia, the limb must be so manipulated as to enable the displaced bone to retrace the path by which it left the joint. When reduction has been effected, the joint must be kept at rest, either by bandaging or by a splint, for a period long enough to allow the torn capsule to heal and the effused blood and synovial fluid to be absorbed. This will usually take about a week, after which massage and movements must be begun and continued daily until the full use of the joint is regained. In some cases gentle massage may be begun earlier still, and is advocated by many as a means of relieving pain and promoting absorption.

*Recurrent dislocations.* In the case of the mandible, shoulder, and sometimes of the hip and other joints, repeated dislocations occur. After the first time only slight force is necessary to reproduce them, and the condition may be due to a variety of causes, amongst which are a lax or unhealed capsule, fracture of some bony prominence necessary for the integrity of the joint, and the feeble support afforded by ruptured or wasted muscles. The immediate treatment is the same as for a primary dislocation,

but some operative measure for the prevention of further recurrence will be called for later.

*Pathological dislocation.* Joints whose bony surfaces have been eroded or whose ligaments have been destroyed by disease are readily dislocated by slight violence, and if there is a history of previous disease the diagnosis presents no difficulties. But it sometimes happens that the dislocation first calls attention to the disease, as occasionally occurs in 'dry caries' of the head of the femur. The pain may be so slight and the disease so insidious that no attention is paid to it until dislocation occurs. These points are only mentioned here to call attention to the necessity for careful investigation of any case presenting unusual features, such as a dislocation of the hip in a young child, or one taking place from slight violence. Such cases as a rule do not present with exactness the attitude and deformity characteristic of the traumatic dislocation of that particular joint.

Another form of pathological dislocation is that which occurs as a sequel of certain acute fevers, such as scarlet fever. It most frequently affects the hip, and is probably due to distension of the joint with fluid, softening of the ligaments, and then to some slight force which brings about the actual displacement. Such a displacement must be reduced as soon as possible, and recurrence prevented by appropriate splinting.

### INDIVIDUAL DISLOCATIONS

1. *Temporo-maxillary joint.* Dislocation of the lower jaw may be unilateral, but is more commonly bilateral. The diagnosis is easy. The mouth is held open and cannot be closed, the chin is prominent, and a hollow can be felt in front of the ear where the condyle should be palpable. At the same time there is great pain, and saliva dribbles from the mouth. If the dislocation is unilateral, the chin is protruded towards the sound side.

*Treatment.* Reduction is effected in the following manner: the thumbs, protected with a roll of lint, are placed against the lower molar teeth, and make pressure downwards and backwards. At the same time, the fingers grasp the body of the jaw each side, and raise the chin. The muscular spasm may make this reduction very difficult, but under an anæsthetic it is a remarkably easy dislocation to reduce.

After replacement has been effected the jaws should be kept bandaged together for a week, feeding being carried on through a tube passed behind the molar teeth. The patient should not be

allowed to masticate solid food for at least a fortnight, for this is one of the situations in which recurrent dislocations are not uncommon.

2. *Sterno-clavicular joint.* The sternal end of the clavicle may be displaced forward, upward, or backward. Of these three uncommon dislocations the first is the least uncommon. The clavicle rides upon the front of the sternum, forming a marked prominence beneath the skin. The diagnosis is easy, but in an old-standing case the lump may be mistaken for a gumma or a sarcoma. Reduction is effected by bracing back the shoulders and manipulating the bone into place. Its retention in position is no easy matter, but is best accomplished by a figure-of-eight bandage passed from shoulder to shoulder across the back, and a pad firmly bandaged over the joint in front. When upward or backward dislocation occurs, the most prominent symptoms are those of pressure upon the trachea and great vessels at the root of the neck. Reduction may be effected in a manner similar to that used for forward displacement, but if that fails, an open operation should be performed and the end of the clavicle either levered into position or resected.

3. *Acromio-clavicular joint.* The outer end of the clavicle rides upon the acromion process, forming a marked prominence. It is readily reduced by drawing the shoulders backwards, but is difficult to keep reduced, and is liable to recurrence. The most convenient method is one similar to Sayre's method of treating fracture of the clavicle, combined with the bandaging of a firm pad over the articulation. If recurrence takes place, and the deformity is not objected to, there is no harm in leaving it unreduced, for a new joint will form and the strength and usefulness of the arm are in no way interfered with. Wiring of the bones together is sometimes performed, but has little to recommend it.

4. *Shoulder-joint.* This joint suffers dislocation much more frequently than any other. The head of the humerus leaves the capsule at its inferior part, and then travels either forward, so as to come to lie beneath the coracoid process, or backward, so as to lie beneath the scapular spine. The former is much the more common. Other forms are described, but they are for the most part only varying degrees of either the forward or backward displacement.

(a) *Forward or subcoracoid displacement.* The signs by which this dislocation can be recognized are: the arm is held away from the side, with the elbow backward, and cannot be brought down to the chest; the shoulder is flattened, and the head of

the bone can be felt in its new position beneath the coracoid process; the head is inclined towards the shoulder. If there is any doubt, as there may be in a very fat or muscular patient, a skiagram should be taken (see also p. 129). Kocher's method of reduction is shown in the accompanying illustrations (Figs. 30-33). Whilst the arm is rotated outwards as much as possible the elbow is brought across the front of the chest. Then, with a combined movement, the arm is internally rotated and brought down to the side. The manœuvres should be repeated until success is obtained. Under an anæsthetic there is usually no difficulty in reducing the dislocation.

(b) *Backward or subspinous displacement.* Here, again, the arm is held away from the side and the elbow cannot be placed against the chest, but in this case it is held forward instead of backward, and the head of the humerus forms a striking prominence beneath the spine of the scapula. To reduce this dislocation similar movements to those above described are to be carried out, but in the reverse direction.

After reduction the arm should be bandaged to the side with a pad in the axilla. In a few days massage may be commenced, and at the end of a week gentle movements should be begun, the arm then being kept in a sling instead of being bandaged to the side.

5. *Elbow-joint.* (a) The common dislocation at this joint is that of both bones backwards. Many other forms of displacement occur either alone or combined with fracture, but they are not difficult to recognize if the bony points of the two elbows are carefully compared (see p. 132).

In the common dislocation, the elbow is held semi-flexed and immobile, the radius and ulna form a marked prominence behind, and the lower end of the humerus can be felt projecting anteriorly. The method of reduction is shown in Fig. 34. The humerus being steadied between the knee and the hand, a combination of traction and flexion is exerted upon the patient's forearm. In an uncomplicated case there is no difficulty about reduction, especially if an anæsthetic is given. As there is no tendency for recurrence to occur, unless the coronoid process has been fractured, there is no need to use a splint. Massage and movements should be begun on the second or third day and the arm kept in a sling.

(b) There is a peculiar injury in the elbow which is frequently seen in children, and is known as 'pulled elbow'. It is produced by dragging a child along by the hand, and is said to be due to the interposition of a fold of the orbicular ligament between the



FIG. 30. First position.



FIG. 31. Second position.



FIG. 32. Third position.



FIG. 33. Fourth position.

REDUCTION OF DISLOCATED SHOULDER.

head of the radius and the capitellum. The signs are pain and limitation of movement, especially of supination, without any alteration in the relations of the bony points about the elbow, and without any signs of fracture. The condition can usually be rectified by pronating the hand and then sharply flexing the elbow.

6. *Wrist.* Dislocations of the wrist are rare. The only one at all likely to be met with is the backward displacement, in which the deformity at first sight resembles that of a Colles's fracture. It is to be distinguished from the latter by the fact that the relation



FIG. 34. Reduction of dislocated elbow.

of the two styloid processes to one another is unaltered, and that the outline of the carpal bones upon the dorsum of the hand can be made out. Reduction is effected by traction upon the hand and manipulation, after which an anterior splint should be worn for a few days. Massage must be begun on the second or third day.

7. *Metacarpo-phalangeal joint of the thumb.* The thumb is extended at the carpo-metacarpal, and flexed at the inter-phalangeal joint, whilst at the metacarpo-phalangeal joint the head of the metacarpal bone forms a prominence anteriorly, and the base of the first phalanx rests upon its dorsum. Reduction may be extremely difficult, being hindered partly by the tension of the long flexor tendon, partly by the metacarpal head being gripped between the sesamoid bones and their attached tendons,

and partly by the meniscus attached to the anterior ligament of the joint. Reduction may be accomplished by grasping the joint between the finger and thumb of the left hand, and with the right forcibly exerting traction upon, and at the same time extending, the thumb (Fig. 35). After reduction the thumb should be fixed in the extended position by means of a plaster of Paris spica. If manipulation fails, the joint must be opened, the obstructing structure drawn aside, and reduction effected by combined manipulation and leverage with blunt instruments.



FIG. 35. Reduction of dislocated thumb.

8. *Hip-joint.* The commonest form of dislocation at the hip is that in which the head of the femur travels backwards and takes up a position upon the dorsum ilii. This is the dorsal dislocation. The uncommon forms are named according to the position occupied by the displaced femoral head, namely, sciatic, pubic, and obturator. There are thus two chief backward and two chief forward dislocations.

(a) *Backward dislocations.* The attitude assumed is characteristic. The thigh is flexed, adducted, and inverted: it is immovable at the hip; measurements show shortening of the limb with elevation of the great trochanter; and the femoral head may be felt upon the dorsum ilii. Reduction is to be effected as follows: the patient must be anæsthetized, and is most conveniently placed upon the back on a mattress laid upon the floor.



Whilst an assistant steadies the pelvis, as shown in Figs. 36-39, the surgeon makes traction upon the thigh, using the wrist or forearm placed in the fold of the flexed knee, and first increases the deformity by flexing, adducting and inverting the thigh still further. He then, still exerting traction, reverses the movements by everting, abducting, and finally extending. The whole manipulation should be carried out smoothly and evenly in one continuous movement. By this means the head of the femur is made to retrace its path and enter the acetabulum through the rent in the capsule at its lower and anterior part.

(b) *Forward dislocations.* The attitude assumed differs from that of a backward dislocation in that, although flexion is present, the thigh is abducted and everted instead of adducted and inverted. There is little or no shortening, and the head of the bone can be felt in its new position, whilst the normal prominence of the great trochanter is absent.

The mode of reduction is similar to that just described, except that the movements are reversed. Whilst traction is exerted upon the thigh, it is flexed, abducted, and everted, and then with one continuous movement it is inverted, adducted, and finally extended.

*After-treatment.* If the patient is to be kept in bed, a Liston's long outside splint should be applied, and daily massage together with gentle movements of the joint should be employed. At the end of ten days the splint may be discarded. If treatment in bed is not desired, a light plaster of Paris spica should be applied, so as to immobilize the joint, and the patient allowed to get about on crutches. After a week or ten days the splint should be removed and the limb massaged daily. The former plan is the better, as wasting and stiffness are largely or entirely avoided. The possibility of a certain degree of permanent wasting, stiffness, persistent pain, and consecutive osteoarthritis, especially in persons past middle life, should always be explained to the patient. These are not uncommon sequelae, even after early reduction and systematic massage, owing to the great amount of damage done to the soft parts. The employment of hot-air and radiant-heat baths forms a useful addition to the massage treatment.

9. *Knee-joint.* Although displacement of the semilunar cartilages is very common, dislocation of the bones constituting the knee-joint is rare. Such an accident would be readily recognized, and reduction by manipulation under an anæsthetic would present no difficulties. The after-treatment comprises



FIG. 37. Second position.



FIG. 39. Fourth position.



FIG. 36. First position.



FIG. 38. Third position.

REDUCTION OF BACKWARD DISLOCATION OF THE HIP-JOINT.

early and persistent massage of the whole limb, combined with the use of a hinged leather splint to be worn for some months afterwards.

*Dislocation of the patella* usually takes the form of a displacement outwards and is commonly associated with genu valgum or with paralysis of the vastus internus muscle. Relaxation of the quadriceps extensor muscles, either by means of an anæsthetic or by extension of the knee combined with flexion of the hip, enables the patella to be replaced by manipulation. Other less common dislocations of the patella occur from time to time; they are readily recognizable and must be treated upon general principles. Once such a dislocation has occurred it is very liable to recur, in which case some operation such as osteotomy of the lower end of the femur, or shortening of the inner part of the quadriceps tendon, might be advisable.

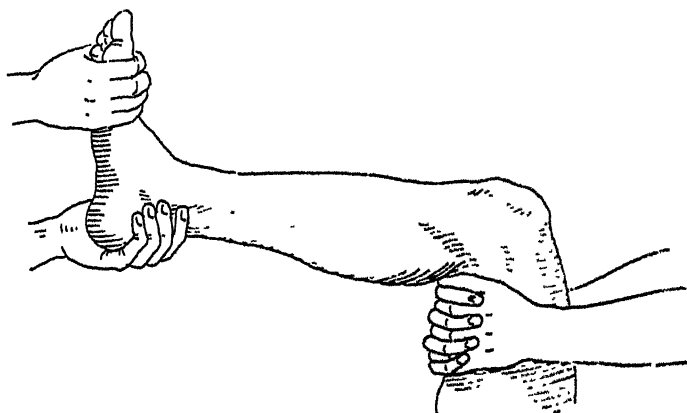


FIG. 40. Reduction of a dislocated foot.

10. *Ankle.* Dislocations of the ankle uncomplicated by fracture are rare. Lateral displacement without fracture cannot occur, but occasionally the foot is dislocated backwards, and very rarely forwards or even upwards between the tibia and fibula. The injury is easy of recognition, but a skiagram should be taken to decide the question as to whether there is any concomitant fracture or not. Under an anæsthetic the dislocation can readily be reduced by traction upon the foot whilst the knee is held fixed (Fig. 40); daily massage and movements should be begun at once.

11. *Foot.* All the dislocations which occur between the tarsal and metatarsal bones are rare. They would be diagnosed by

careful comparison of the bony points with those of the sound foot, and the exact nature of the injury should be confirmed by an X-ray examination. Reduction under an anæsthetic should be followed by early and persistent massage. Resection is sometimes required for dislocation of individual tarsal bones.

### *E.* DISEASES ASSOCIATED WITH ACUTE ARTHRITIS

It may be stated as a general rule that acute arthritis of rapid onset is so extremely painful and is attended with such constitutional symptoms that it may fairly be considered as an emergency. The effusion in a neuropathic joint, seen mainly in tabes and in syringomyelia, is often of sudden onset and may be painful also ; such cases sometimes constitute emergencies.

The importance of an accurate diagnosis of the nature of an acute arthritis can hardly be over-estimated, but this at times is a matter of considerable difficulty, inasmuch as the local manifestations of swelling, pain, and possibly flushing of skin with œdema, may be produced by totally different diseases, at any rate in the early stages of an arthritis. The diagnosis will, therefore, often have to rest on a general consideration of the whole circumstances of a case rather than on the local disturbance of the joint alone.

Unfortunately the pathology of the various types of arthritis is at present too obscure to allow of any good system of classification, and it is sometimes impossible to determine the exact nature of an inflamed joint. Certain general principles are, however, helpful and they may be considered under the following headings.

(i) *Age.* Infants are not often affected with acute joint disease, though a suppurative arthritis does occasionally occur from infection conveyed *via* the umbilical cord, or from gonorrhœal ophthalmia in the newborn, or later from vulvo-vaginitis.

Acute rheumatism is very rare in children under two years, and in older but still young children it should be remembered that the local manifestations are very slight and may merely be represented by fleeting 'growing pains', though endocarditis and pericarditis may give a clue to the diagnosis.

Acute epiphysitis is not uncommonly mistaken for acute rheumatism. In the former the local swelling and pain are very marked ; only one joint is attacked ; the temperature is high, and the child is very ill. Owing to the urgent need for surgical

treatment and the danger of destruction of the joint, this condition should be carefully examined for in any infant with severe pain in a limb.

Another condition which is sometimes mistaken for arthritis in a young child is seen in scurvy rickets. Subperiosteal hæmorrhage occurs, especially in the femur and tibia. This may involve the whole of the shaft or may be localized towards the end of the bone, and on superficial examination may give rise to the diagnosis of arthritis, the extreme tenderness and the immobility of the limb apparently confirming this; but careful examination will show that the joint is free and that other symptoms of scurvy such as anæmia or subcutaneous ecchymoses are present. Want of attention to these points has led to incision into joints on the supposition of arthritis, or of the shaft of the bone on suspicion of acute periostitis.

Children are subject to tuberculous disease of joints, but the onset is commonly insidious, and it is very exceptional for a tuberculous joint to manifest itself as a severe acute arthritis.

In hæmophilia, again, although the joint affection is usually of gradual onset, yet it is sometimes sufficiently rapid to suggest some form of acute arthritis.

In the young adult acute rheumatism is common. Gonorrhœal rheumatism is also very common and gout is occasionally met with. In older subjects gout and osteo-arthritis are frequent. Septic arthritis may of course be met with at any age.

(ii) *Arthritis a secondary symptom of other diseases.*

Infective arthritis is an occasional complication of other diseases, and it is very important always to make a careful general examination for the possible presence of such in any obscure case.

(a) *Scarlet fever.* The joints may be affected in two ways. The more common is known as scarlatinal rheumatism; it occurs about the end of the first week of the disease, affects the arm more frequently than the leg, and the wrists and metacarpal joints most commonly; recovery is usually rapid. Its occurrence may settle the nature of a doubtful rash. In the second and graver form suppuration occurs in the joint.

(b) *Pneumonia.* The pneumococcus invades the joint and gives rise to local swelling and redness. It is a rare complication of pneumonia; constitutional symptoms are severe, and unless incisions are made promptly and the joint thoroughly drained the case may be fatal or the joint destroyed. It has also occurred as a primary affection (see p. 168).

(c) *Enteric fever* occasionally gives rise to arthritis. Pain,

swelling, and redness may occur, and the condition may go on to suppuration.

(d) Other acute fevers occasionally set up arthritis, such as measles, mumps, influenza, small-pox, dysentery and cerebro-spinal meningitis.

(e) *Gonorrhœa*. Arthritis is common. One joint alone may be involved or it may be polyarticular. We may mention here that the common mistake of regarding gonorrhœal arthritis as acute rheumatism should be carefully guarded against. The patient is usually quite ignorant of the connexion between a gleet and the joint mischief, and unless asked will not volunteer the information. In the female, too, the local manifestations of gonorrhœa may be very slight and a bacteriological examination of the vaginal secretion may be advisable. The practitioner should also be alive to the possibility of wilful denial of infection.

(f) *Pyogenic infections*. Secondary arthritis may occur in any form of pyogenic infection such as pyæmia, malignant endocarditis, erysipelas, and bone suppuration; in fact it may develop whenever there is a primary focus of infection anywhere in the body. Such a focus may easily be overlooked or disregarded, as in the case of chronic otitis media or pyorrhœa alveolaris.

It is probable that some acute or subacute cases which for want of better knowledge we term osteo-arthritis are the result of the infection of a joint by organisms whose primary site is elsewhere and undiscovered, in the buccal, nasal, respiratory, alimentary and genito-urinary tracts.

(iii) *Number of joints affected*. One joint only may be affected, or there may be a widespread multiple arthritis. A single joint is involved not uncommonly in gonorrhœal arthritis whilst this is unusual in acute rheumatism. Polyarthritis is the rule in acute rheumatism and also occurs in gout, though in the early attacks a single joint is usually affected. Acute osteo-arthritis in rare instances presents itself as a polyarthritis indistinguishable at first from acute rheumatism.

(iv) *Affection of special joints*. Gout has a special predilection for the metatarso-phalangeal joints of the big toes, and though in later attacks these may be unaffected it will usually be found that they have suffered in the past. Occasionally, however, the first attack may centre itself in the knee or shoulder, and the diagnosis may then be more difficult. Assistance may be obtained from a history of alcohol or over-feeding, a family history of gout, the presence of tophi in the ears, albuminuria or evidence of lead poisoning.

In acute rheumatism the knees, ankles, shoulders, wrists and hands are frequently attacked, whilst gonorrhoeal rheumatism, though common enough in the same joints, is also seen in joints rarely affected by acute rheumatism, such as the sterno-clavicular, temporo-maxillary, intervertebral and sacro-iliac.

In osteo-arthritis the most acute form is polyarticular, but this is a rare condition. The monarticular variety specially affects the knee, hip and shoulder; the joint may swell rapidly and severe pain may be present. There is also a common variety with special incidence on the finger joints and with recurring acute and subacute exacerbations. The finger joints are also specially affected in the disease described by Still, in which there are fusiform swellings of the joints, with anæmia and enlargement of the glands and spleen.

(v) *The character of the joint lesion.* Any acute inflammation of a joint is associated with swelling and pain and often with redness of the skin. The peri-articular tissues are often involved, slightly in acute rheumatism, and to a considerable degree in gonorrhoeal arthritis, in which there is often a brawny reddish brown swelling extending for a considerable distance above and below the joint. In gout there is much swelling, and when the foot is affected the skin is hot, red and shiny with much subcutaneous thickening; with involvement of the ankle-joint cedema may spread for a considerable distance up the leg. It is not always easy in the case of the ankle to make certain that the joint is actually involved. Cellulitis or teno-synovitis may closely simulate arthritis, but careful examination will usually show whether movement of the joint is free or whether the peculiar creaking of teno-synovitis is present. We have sometimes been quite unable to determine the nature of swellings in the neighbourhood of the ankle-joint accompanied by pain, cedema and redness, which have subsided with local fomentations and with internal medication. Erythromelalgia will probably account for some of these obscure cases.

Swellings of the wrist and carpal joints also give rise to difficulty. There is often marked swelling of the back of the wrist and a puffy or brawny swelling of the dorsum of the hand. This may occur for instance in gout and in gonorrhoeal arthritis, but it may be very difficult to exclude cellulitis, and the diagnosis may only be settled by evidence of suppuration.

Pyæmic joints may be intensely painful and attended with rigors and marked constitutional symptoms, but sometimes they are almost free from pain and insidious in their development.

In the later stages of osteo-arthritis, with erosion of cartilage, bony grating may be elicited, whilst in earlier stages fine or coarse creaking may be felt. Such joints are liable to recurring attacks of acute inflammation and the presence of grating or creaking, together with the age of the patient, will indicate the nature of the trouble.

(vi) *Bacteriological examination of the joint effusion.* Cases of arthritis which do not conform to recognized types necessarily give rise to great difficulty in diagnosis. This applies particularly to arthritis confined to a single joint. We repeat that most careful examination should be made for some primary focus of disease such as gonorrhœa, otitis media, endocarditis, and so forth. Recourse may also be had to aspiration of the joint fluid which may then be investigated by histological and bacteriological methods. This might well be done more frequently than is at present the custom. The strictest attention must be paid to every detail of asepsis, particularly with regard to the disinfection of the skin through which the puncture is to be made. The exploring needle and syringe should be boiled for *five* minutes. The fluid withdrawn should be expelled from the syringe into a sterile glass-stoppered bottle for subsequent examination by a pathologist, or, better still, tubes of culture media may be inoculated there and then.

The fluid may be purulent and cover-slip preparations may at once show the type of organism present, so that the proper and even specific line of treatment may be adopted without delay; otherwise the treatment must necessarily be carried out on general lines until the full bacteriological examination has been made. Failure to find any organisms in the fluid, even on cultivation, may still leave one in doubt as to the nature of the disease, but it serves to exclude the commoner pyogenic infections.

Incidentally the relief afforded by withdrawing the fluid from an acutely distended joint is very great; and indeed the intense pain in some cases justifies aspiration as a means of treatment.

### *Treatment*

(a) *Acute rheumatism.* Absolute rest in bed is essential and the patient may with advantage wear a flannel nightgown and sleep between blankets. A dose of calomel followed by a saline aperient should be given at the outset and the bowels subsequently carefully regulated. The diet should be very light and in a severe attack it should be practically restricted to milk.



Owing to the thirst that so commonly accompanies the disease the patient should be allowed to drink freely of water, home-made lemonade or barley-water.

Local treatment is of great importance: the affected joints should be protected by abundance of cotton wool, and a cradle is very useful to protect the limbs from the weight of the bed-clothes. The joints are often wrapped up with lint saturated with Fuller's lotion (carbonate of soda 6 drachms, laudanum 1 oz., glycerine 2 oz., water 9 oz.) or with belladonna liniment,<sup>1</sup> or chloroform liniment. When the pain is very severe great relief sometimes attends the use of a softly padded splint.

Salicylate of soda should be given internally. For an adult gr. xx should be given every two hours for four or five doses, then every three hours for four or five doses, then every four hours for a day or two, then every six hours, and finally three times daily. Sodium bicarbonate is often given with the salicylate, but it is open to doubt whether it has much effect on the disease. It is important to continue the use of the salicylate for at least ten days after the temperature has reached the normal level. The salicylates are apt to be depressing and aromatic spirit of ammonia is a useful addition. Salicin may be used as an alternative and in the same doses. The heart should be examined every day, as pericarditis may develop very insidiously and without pain. For the treatment of pericarditis and endocarditis see Chapter XII, and for the rare complication hyperpyrexia see p. 99.

(b) *Gout*. The treatment of the acute paroxysm of articular gout will alone be considered. The patient must go to bed, with the limb elevated and protected by a cradle. The affected joint should be wrapped up with abundance of cotton wool; this should be heated at a fire before being applied as it then swells up and becomes much softer. Fomentations of hot water or of Fuller's lotion (see above) are often recommended, but the pain is frequently so intense that the patient will not allow the necessary manipulations. Local hot-air treatment may be tried if available.

Internally four or five grains of calomel should be given at the outset and followed by a saline purge. Colchicum is by far the most useful drug in acute gout, and the following formula

<sup>1</sup> The atropine liniment used at St. Thomas's Hospital does not stain the skin or clothes of the patient and has the same alkaloidal strength as the official belladonna liniment. Its composition is:—atropine sulphate gr. 38½, compound tincture of lavender ℥ 100, alcohol (90 %) to 1 pint.

is useful:—vini colchici mxx, pot. cit. gr. xxx, mag. sulph. gr. xv, aq. menth. pip. ad ʒj. This should be given three times daily. It usually affords marked relief to the pain, but as it is often very depressing, it should be discontinued as soon as the acute symptoms subside. If it does not give relief or if the attack does not subside quickly, salicylate of soda gr. xv with potassium iodide gr. v may be tried three times daily.

The diet should be very simple, consisting at first mainly of milk, with eggs and milk puddings.

(c) *Acute gonorrhæal arthritis.* The primary cause, the urethritis, should of course receive attention. Medicinal treatment is not very satisfactory; the salicylates are not nearly so efficacious as in the case of acute rheumatism, but they should be tried. A combination of sodium salicylate gr. xv with potassium iodide gr. v, three times daily is sometimes of service.

Local treatment is very important; if the legs are affected the patient should rest in bed with the affected joints immobilized, if necessary by splints. A cradle is also useful in the very acute cases. An ice-bag or Leiter's tubes may be applied. Counter irritation, especially by means of the thermo-cautery, gives very great relief. The skin round the joint should be lightly touched in from a dozen to twenty places. Patients never complain of this and the relief of pain is often striking. Hot-air baths are also useful. As the acute stage subsides Scott's dressing may be applied, and daily massage and movements employed to minimize the subsequent stiffness. If the local symptoms increase and the temperature rises it may become necessary to incise and irrigate the joint.

Vaccine treatment should be tried if the case fails to improve. The vaccine is best prepared from the patient's own organism, either from the urethral discharge or from fluid obtained by aspiration of the joint (see p. 165). Failing this, a stock vaccine may be employed. The initial dose should be 200 millions and the dose gradually increased up to 1,000 millions, with intervals of ten days between the successive inoculations.

(d) *Acute septic arthritis.* The treatment of this condition when dependent upon direct infection is discussed at p. 146, and as a local complication of acute epiphysitis at p. 72. In pyæmia the joint affection is not, as a rule, so acute as in the foregoing instances; indeed some cases are so mild that they may be overlooked unless the patient is systematically examined from time to time from this point of view. A small and painless effusion into a joint in pyæmia may subside if the limb is merely

immobilized and treated with hot fomentations; a more acute case may require aspiration only, when the fluid may be found to be clear or only slightly turbid; a still more severe case must be treated on the lines laid down for suppurative arthritis of local origin (p. 146).

(e) *Pneumococcal arthritis*. As already stated, this may occur as a complication of pneumonia, but it may also be due to some other pneumococcal affection, such as otitis media, and it occasionally occurs as a primary affection. It is an extremely grave disease, often proving fatal, and at least threatening destruction of the joint. The treatment is the same as that of an acute septic arthritis.

(f) Arthritis occurring in the course of the acute specific fevers, particularly typhoid and scarlet fever, must be treated on general lines. The chief care must be directed to preventing the dislocation which is so apt to occur. Thus, in the case of the hip, which is by far the most frequently involved, a Liston's long outside splint should be employed. When dislocation has occurred it must immediately be reduced.

## CHAPTER IX

### FOREIGN BODIES IN THE RESPIRATORY, ALIMENTARY, AND URINARY TRACTS

FOREIGN bodies accidentally or wilfully introduced along the natural passages of the body are a frequent source of urgent and even dangerous symptoms. Although they are referred to in other chapters, it has been considered advisable to group them together for the sake of convenient and easy reference. Foreign bodies lodged in the ear and eye are dealt with in Chapters XXI and XXII respectively.

#### I. RESPIRATORY TRACT

1. *Nose.* All kinds of small objects, such as peas, pebbles, and beads, have been met with in the nose, particularly in children. Unless speedily removed they are apt to set up ulceration of the mucous membrane, and even disease of the bones. A unilateral nasal discharge in a child is always suggestive of the presence of a foreign body.

*Treatment.* Syringing, in such a way that the stream runs into the unaffected nostril and out of the affected one, may succeed in dislodging the object. If this fails, an anæsthetic should be given and the foreign body extracted by means of forceps or a scoop.

2. *Pharynx.* See p. 174.

3. *Larynx, Trachea, Bronchi.* The inhalation of a foreign body which passes into or beyond the larynx is an accident the gravity of which can scarcely be over-estimated. The mortality estimated by von Bruns from a large mass of statistics is no less than 33 per cent. Since the introduction by Killian of the bronchoscope this rate of mortality is doubtless, in the hands of those accustomed to the use of this instrument, greatly diminished. In most cases neither the instrument nor the skill to use it is available, and simpler if less efficient means have to be employed. In some instances death occurs before help can be summoned, as when a foreign body completely occludes the rima glottidis; but in the majority of fatal cases death is due to the secondary effects

produced by the retention of the invading object ; so that no effort must be spared to remove it at once, in view of the risks which attend what is euphemistically termed ' expectant treatment '.

Large, rough, and angular objects are likely to remain above the vocal cords ; small, smooth and rounded ones will generally pass through the rima glottidis and lodge in the trachea or in one of the bronchi. A coin may lodge in the larynx and then, owing to alteration of its position by coughing or attempts to extract it, slip through the rima glottidis into the trachea.

The symptoms and treatment vary with the final place of lodgement.

(a) *Larynx.* In many cases the reflex cough expels the foreign body at once, so that the patient never comes under treatment ; more rarely, death rapidly ensues from suffocation. In the intermediate class of cases the symptoms are pain, cough, alteration of voice, dyspnœa of varying degrees of urgency, and often great mental distress. Crile has shown that a severe degree of collapse may ensue from reflex inhibition of the cardiac and respiratory functions. Whilst the patient lies quiet, and the foreign body is but a small one, the distress may be slight, and stridor may scarcely be audible, but on disturbance or exertion these symptoms may suddenly become of an alarming character. Every now and then there will be paroxysms of coughing, in one of which the foreign body may be ejected together with a quantity of mucus. On the other hand, it may, if small enough, slip down between the cords into the trachea, and find a resting place in one of the bronchi.

*Treatment.* The diagnosis, rendered probable by the symptoms and history, may be confirmed by a laryngoscopic examination, when it may be easy to proceed at once with its removal by forceps. Most of the patients, however, are children, in whom intra-laryngeal manipulation is more difficult and requires the administration of a general anæsthetic, so that other methods may first be tried. Nothing, however, must be done, except in cases of extreme urgency, until the tracheotomy instruments are at hand. An attempt may then be made to dislodge the foreign body by lowering the patient's head and inducing a cough, or passing the finger into the pharynx so as to cause him to vomit. An emetic is sometimes given with the same object. If these means fail extraction must be attempted by means of forceps, aided by the laryngeal mirror. In the case of a child, the patient should be held in a sitting posture on a nurse's lap, whilst the operator sits opposite the nurse, and the anæsthetist steadies

the child's head and at the same time holds the gag in place. It must be remembered that both the administration of an anæsthetic and the manipulations of laryngoscopy are apt to induce an attack of urgent dyspnoea, and it is for this reason that the surgeon must be prepared, before beginning any such manipulation, for the immediate performance of tracheotomy should the need for it suddenly arise (see p. 200).

Sometimes a foreign body such as a tooth-plate cannot be removed with forceps because of its impaction in the larynx, and if there should be a hook upon the plate extraction through the mouth may be effectually prevented. In such a case recourse must be had to the operation of thyrotomy.

*Thyrotomy.* Tracheotomy is first performed, and the trachea above the tube packed with a strip of gauze. If a special sponge-covered tracheotomy tube is available, it may be used with advantage. A vertical incision is then made in the mid-line over the larynx, the fasciæ divided, and all hæmorrhage arrested. The alæ of the thyroid cartilage are to be separated by a vertical incision made exactly in the mid-line, and held apart as widely as possible with sharp hooks. The foreign body can then be seen, and extracted with forceps. After removal, the cartilages are to be approximated accurately with fine sutures passed through the perichondrium and superjacent tissues, and the wound closed. The tracheotomy tube is to be left in for a few days, during which time the patient is kept in bed, protected by a tent in which the air is kept moist by means of a steam-kettle.

*After-treatment.* However the foreign body may have been removed, the patient should be kept in bed for a few days in a warm room, and such precautions taken as may render prompt action possible should laryngeal cedema necessitate tracheotomy or intubation. A soft or even fluid diet may be required on account of pain on swallowing.

(b) *Trachea.* A foreign body has to be small enough to pass through the rima glottidis, so that the greater number, especially if heavy and smooth, pass lower down into one of the bronchi. Some, however, especially if light and possessing rough or sharp surfaces, are arrested in the trachea. They commonly become coated with mucus, and to such an extent that an artificial tooth may be so embedded as to give rise to the impression that it is a soft body. Certain bodies, such as beans, may swell considerably after lodgement, and so produce a steadily increasing obstruction to respiration.

*The diagnosis* of the presence of a foreign body in the trachea depends (a) upon the history of something having passed down the throat ; (b) upon a very severe attack of dyspnœa and coughing consequent on its passage through the larynx ; (c) upon the symptoms due to its presence in the trachea ; (d) upon the absence of the unilateral symptoms peculiar to bronchial obstruction ; and (e) in some cases, such as an impacted coin, upon the direct evidence yielded by a skiagram.

The direct tracheal symptoms are, firstly, those of *obstruction*, namely dyspnœa, varying in intensity according to the movement of the body in the trachea. Secondly, those of *irritation*, namely a paroxysmal cough which is made much worse when the body is coughed up against the under surface of the vocal cords ; fatal asphyxia has often been produced in this way. Thirdly, those of *inflammation* ; tracheitis is set up and frothy mucus is expectorated during the paroxysms of coughing.

*Treatment.* As such a body has passed through the rima glottidis, it is only reasonable to suppose that it can be ejected by the same route, unless it has been present long enough to have become fixed by œdema, by ulceration of the mucous membrane around it, or by being embedded in mucus. It must not be forgotten that attempts to bring about removal by shaking the patient may be followed by dangerous laryngeal spasm, and no such attempts should be made unless the surgeon is prepared to perform instant tracheotomy.

The head should be lowered and the chest raised ; the foreign body, unless impacted, may thus be made to roll towards the larynx, when it may be expelled by a fit of coughing. If it is thought wise to give chloroform for this purpose, the degree of anæsthesia should of course be very light.

If the foreign body has been seen on laryngoscopic examination or a skiagram has revealed its exact position, and if the operator possesses the necessary experience, an attempt might be made to remove it with tracheal forceps. Here again everything should be ready for immediate tracheotomy in case the efforts to remove it caused such a change of position of the body as to produce more complete obstruction. Failing expulsion by these means, the trachea should be opened and the body searched for and removed (see below, p. 174). If the body cannot be found, the wound in the trachea should be kept widely open by suitable stitches in the hope that the body may subsequently be expelled during an attack of coughing, but this is a procedure only to be used as a last resort on account of

the dangers which attend the non-removal of a foreign body (see p. 174).

(c) *Bronchus*. The passage of the foreign body through the larynx will produce the symptoms described in the preceding section. The body may remain for a short time in the trachea, giving rise to the symptoms peculiar to tracheal obstruction, and may then make its way into one or other bronchus; or it may fall immediately into a bronchus. The right bronchus is much more commonly affected than the left because it is larger and in a more direct line with the trachea.

The immediate risk to life is less than in the case of tracheal obstruction as one lung is available for respiration, whereas a foreign body in the trachea may completely obstruct the passage of air. Removal is therefore not so urgently required so far as life is concerned, but it should be undertaken as speedily as possible because the longer the foreign body remains in the bronchus the more difficult may it be to remove, on account of fixation by œdema or ulceration, and further, there is grave risk of the development of bronchiectasis.

*Symptoms and physical signs*. Dyspnoea is present and is often paroxysmal in character. It is most urgent at first, and subsequently diminishes as the other lung adjusts itself to its additional work. The irritation caused by the body gives rise to cough and expectoration.

The respiratory movements of the affected side of the chest are impaired or absent. On auscultation the physical signs vary with the degree of obstruction. If complete, breath sounds are absent: if incomplete, stridor may be audible, especially over the root of the lung, and rhonchi may be present, most marked over the site of the obstruction. Vocal fremitus and vocal resonance are diminished. Dullness to percussion speedily develops owing to the collapse of the lung, which is produced partly by a ball-valve action of the foreign body and partly by absorption of air from the alveoli. The side of the chest, therefore, speedily becomes retracted. Later, signs of bronchiectasis develop.

*Diagnosis*. The history of a foreign body being 'swallowed' is of the greatest importance. In the case of a child it may of course not be forthcoming. Suddenness of onset is very characteristic, but this may be equally marked, for instance, on rupture of a broken down bronchial gland into a bronchus. The presence of a foreign body should be suspected in the presence of sudden onset of the above symptoms, and an X-ray examination should always be made.



*Treatment.* As a preliminary measure the patient may be inverted and shaken, using the same precautions as those described in the preceding section (p. 172).

Failing success by this method, a low tracheotomy should be performed and an attempt made to find and seize the object with forceps. With a low tracheotomy, especially in a child, it is surprising with what ease the forceps can be passed into either bronchus. Even if the forceps cannot be made to grasp the foreign body, it may happen that the irritation of their introduction brings about such a fit of coughing as to dislodge the foreign body and to bring it within reach of the forceps or of a scoop.

In this operation it is a great advantage to have the chest well raised and the head lowered. A forehead light is essential, and enables the operator to see into the bronchi with great ease.

In some cases a foreign body can be removed from a bronchus by means of 'bronchoscopy', namely, manipulation through a long tube passed through the larynx into the trachea. As the apparatus necessary is not likely to be available in case of emergency, except in the practice of a large hospital, and as its use requires special skill and practice, it will not be described here.

It cannot be insisted upon too strongly that the retention of a foreign body in a bronchus is almost certain sooner or later to be followed by a fatal result, and no effort should be spared to secure its removal. To wait in the hope that it may ultimately be loosened by ulceration and expelled by coughing, or evacuated with the pus of an abscess, is to allow the patient's chances to hang upon a very slender thread.

## II. ALIMENTARY TRACT

(a) *Pharynx.* Large masses of food sometimes become impacted in the pharynx, so as to threaten suffocation. The obvious method of dealing with such an accident is to open the mouth with a gag or any suitable substitute which may be at hand, and to dislodge the mass with the forefinger. Should this prove difficult,\*and the patient be in danger of suffocation, laryngotomy should be performed, an operation of emergency which can quite well be done with a penknife (see p. 199).

Coins of large size may become lodged in the pharynx, where they are almost invariably arrested at its narrowed lower end, just above the cricoid cartilage, and in such a manner that the

two surfaces look backwards and forwards. There is little difficulty in removing them, either with the finger, forceps, or coin-catcher, but unless promptly dealt with they are apt to cause ulceration of the pharyngeal wall, with its attendant dangers of sepsis and laryngeal cedema.

Smaller and sharp objects such as pins and fish-bones may be arrested in the pharynx, either by their points piercing the mucous membrane, or by becoming entangled in the folds and fossæ about the root of the tongue and upper aperture of the larynx. They may be felt with the finger or seen with the laryngoscope, and extracted by means of forceps. Whenever the mucous membrane has been penetrated there is the risk of dyspnœa arising from cedema, and precautions should always be taken for dealing with this emergency should it occur.

(b) *Œsophagus*. As a rule the patient is able to locate with tolerable accuracy the position at which a foreign body has become arrested in the œsophagus. In examining such a case, the use of the œsophageal bougie should be avoided, as much harm may be done, whilst little information is likely to be gained. The bougie usually slips quite easily past a foreign body, which may thus be overlooked until dangerous complications arise. The two methods which give the most satisfactory results are œsophagoscopy and radiography. The latter method is only of use when the foreign body is partly or wholly composed of metal or other substance opaque to the rays, but these fortunately constitute the majority. Œsophagoscopy is an accurate method of diagnosis, and is also of use in many cases for the removal of the object, but it requires both special apparatus and special skill, and will not be further referred to here.

*Treatment*. All foreign bodies lodged in the œsophagus require removal at the earliest possible moment, since neglect not only makes the operation more difficult, but also invites ulceration of the œsophageal wall with its attendant dangers of perforation into the mediastinal or cervical cellular tissue, into the pleura, or into a large blood-vessel.

Small objects such as pins and fish-bones can usually be removed by means of the umbrella probang (Fig. 41). This instrument, softened in hot water and lubricated with glycerine, is passed in the same manner as a stomach tube, until its expandible end is beyond the site of the foreign body. As it is withdrawn the horsehair portion opens out and brings the foreign body with it. Several attempts may have to be made before success is attained.

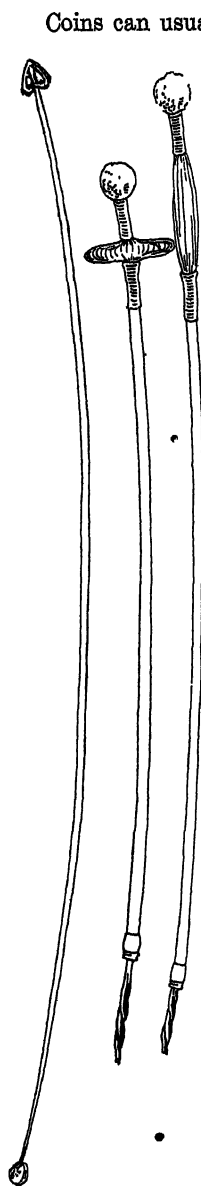


FIG. 41. Coin-catcher, and umbrella probang open and shut.

Coins can usually be removed with the coin-catcher (Fig. 41), which is used in the same manner as the umbrella probang. If high up they may, in children, be reached with the œsophageal forceps. When situated near the cardiac end, they may be pushed on into the stomach, and allowed to pass *per vias naturales*. When a coin or other small object of a like nature is being withdrawn from the œsophagus, the patient should be recumbent, with the head thrown back, in order to avoid the possibility of the foreign body slipping back into the larynx.

It must be remembered that after removal of a foreign body, or after it has passed into the stomach, the pain on swallowing and the sensation of its presence may remain for hours or days, so that the patient may feel himself unrelieved.

The removal of a tooth-plate, if furnished with hooks, may present a most formidable task, and the impaction of such an object in the œsophagus is an accident by no means devoid of danger to life.

When the plate has been accurately located by means of the X-rays, the very gentlest attempt may be made, under an anæsthetic, to move it by means of forceps or the coin-catcher, if it be accessible, but no force whatever must be employed, lest the œsophageal wall be torn. If by this means it is found to be fixed, the case assumes a grave aspect. When situated in the cervical part of the œsophagus, the operation of œsophagotomy becomes imperative; when at the cardiac end, gastrotomy may have to be tried; when in the thoracic portion, it may be found possible to push the foreign body onwards towards the stomach, so as to come within the reach of removal by gastrotomy.

The introduction of the œsophagoscope has rendered it possible

to remove objects from the gullet which previously would have required an open operation. But like the bronchoscope, the œsophagoscope requires special training for its employment, and will not be further referred to here.

The operation of œsophagotomy is so rarely required that a description of it would be out of place here ; reference should be made to the larger textbooks of operative surgery.

(c) *Stomach.* We are not concerned here with those curious cases in which large accumulations of foreign bodies have, in the insane and others, gradually accumulated in the stomach, nor with those which, having been present for a long while, are causing symptoms of chronic indigestion.

Medical men are frequently consulted as to what is to be done when a patient has swallowed some such object as a tooth-plate, a coin, or a pin. Having determined that the body has actually entered the stomach, there is in the majority of cases no cause for anxiety, nor for any active treatment, as the object will find its way into the intestine, and, in the course of a few days, be passed *per rectum*. If no symptoms are present, therefore, the case should simply be watched, the diet consisting of material such as porridge, which leaves a large residue that will englobe and assist the passage of the foreign body. When the object is of metal, its progress can be watched by means of repeated X-ray examinations. If it fails to pass through the pylorus, or is of such a size and nature, such as a large pin, that it cannot be safely left to pass naturally, or is causing severe gastric symptoms, then removal by gastrotomy is indicated. This is an operation which, performed with strict aseptic precautions, is practically devoid of danger.

*Gastrotomy.* A vertical incision is made through the left rectus muscle immediately below the costal margin. The stomach is drawn up into the wound and well packed off with gauze strips. It is then opened by an incision midway between the two curvatures ; there is less hæmorrhage with a vertical incision than with one made in the long axis of the stomach. If the foreign body is in the stomach, it is extracted with forceps, but if impacted in the lower end of the œsophagus it becomes necessary to dilate the cardiac orifice and to introduce a long curved forceps, guided by the finger, into the gullet. After extraction, the stomach is to be closed in two layers, one passing through the whole thickness of its wall, and the second of finer silk, burying the first with a Lambert stitch. The abdominal wound is then closed in layers.

The *after-treatment* consists of feeding with small quantities of fluid nourishment at a time, so as to avoid any distension of the stomach. It is not necessary to withhold food from the stomach altogether even from the first.

(d) *Intestine.* A foreign body which has managed to run the gauntlet of the pyloric orifice is not likely to become arrested in the intestine. Still, such cases do sometimes occur, and removal by laparotomy and enterotomy may be required. The indications for such an operation would be the occurrence of symptoms such as pain and tenderness, or failure of evacuation after a reasonable interval. Here, in the case of bodies composed wholly or partly of metal, the X-rays would be of the greatest assistance.

In the very uncommon event of a foreign body such as a pin or nail being retained indefinitely and giving rise to trouble the tendency is towards gradual perforation by ulceration of the intestinal wall, and the formation of a localized intra-peritoneal abscess.

Intestinal obstruction is occasionally due to the impaction of a foreign body such as a gall-stone in the bowel (see p. 250).

The lodgement of foreign bodies, other than fecal concretions, in the appendix is so rare as to constitute a surgical curiosity. They would only be discovered on the removal of that organ on account of the appendicitis to which they might give rise.

(e) *Rectum.* Small foreign bodies such as buttons, coins, and pins, which have successfully negotiated the whole alimentary canal, may fail to traverse the rectum. If, therefore, such an object has not been passed after a reasonable interval, a rectal examination should be made before it is assumed to have been arrested in some other part of the intestine.

All kinds of foreign bodies are introduced into the rectum by the prurient or insane, and their removal is always a matter of urgency, as cases are on record of perforation into the peritoneal cavity and bladder. In most cases it is only necessary to give an anæsthetic, stretch the sphincter, and extract the foreign body by means of forceps.

### III. URINARY TRACT

(a) *Bladder.* Objects such as pins, penholders, pieces of twigs, and pieces of broken catheters, introduced either wilfully or accidentally into the bladder, soon set up cystitis, and become coated with phosphatic deposit, giving rise to the symptoms of

vesical calculus. The history is usually sufficient for diagnosis, but, if it is considered necessary, the cystoscope may be used to ascertain the position and size of the mass which requires removal. It may also be felt by rectal or vaginal examination.

In the female, removal should be effected by dilating the urethra, which can readily be made to admit the forefinger, and extracting with forceps. In the male, a small object may be successfully removed by a specially skilled operator *per urethram* with the aid of the cystoscope, but the simplest method is to perform suprapubic cystotomy (p. 319), after which, if there is no cystitis, the bladder may be sutured at once, a drain being left down to the vesical wound in case of leakage.

(b) *Urethra*. A stone descending from the bladder, or some object wilfully introduced into the urethra, may become impacted, and cause a partial or complete obstruction to the flow of urine. It is important to remove such an obstruction at the earliest possible moment, on account not only of the retention, but also of the risk of ulceration of the mucous membrane, with its possible sequelæ such as peri-urethral abscess and extravasation. A large number of forceps and other instruments have been devised for the purpose, but it is often a task of the utmost difficulty to grasp a smooth slippery object lying in so confined a space as the urethral canal. During such attempts at removal an assistant should make pressure upon the urethra behind the foreign body so as to steady it and to prevent the object being pushed more deeply towards the bladder. If a reasonably patient attempt with forceps has failed, and it is found impossible by external manipulation to move the foreign body, urethrotomy should be performed.

*Urethrotomy*. The patient being in the lithotomy position, an incision is made in the mid-line over the object to be removed, and the urethra opened. After the foreign body has been extracted, the little wound in the urethra is sutured with catgut, over a catheter, and the skin wound partially closed. The catheter should be retained for a week.

A pin may be removed by pushing its point through the skin on the under aspect of the penis, turning it so that its head faces the meatus, and then pushing it forwards.

When the foreign body is deeply placed, or if it cannot be extracted *per urethram*, it may sometimes be more conveniently pushed on into the bladder, and removed by suprapubic cystotomy.

## CHAPTER X

### AFFECTIONS OF THE RESPIRATORY SYSTEM

IN this section will be considered certain acute or urgent conditions occurring at the onset or during the course of diseases of the respiratory system. For details of the routine treatment of those diseases reference must be made to the larger textbooks.

1. LARYNGITIS AND LARYNGEAL SPASM. See p. 197.

#### 2. BRONCHIAL ASTHMA

The spasm is often cut short and the dyspnoea relieved by inhalations of chloroform or of amyl nitrite. The fumes from burning stramonium are also very efficacious, the following being a good formula: stramonium leaves (powdered),  $\frac{1}{2}$  oz.; anise fruit (powdered),  $\frac{1}{4}$  oz.; potassium nitrate,  $\frac{1}{4}$  oz.; tobacco (powdered), gr. x. The potassium nitrate should be dissolved in 1 oz. of water and the solution mixed uniformly with the powders and dried. One teaspoonful should be ignited on a plate, and the fumes inhaled.

A hypodermic injection of five minims adrenalin chloride solution gives prompt relief to a paroxysm. A hypodermic injection of morphia, gr.  $\frac{1}{8}$ – $\frac{1}{4}$ , with atropine sulphate gr.  $\frac{1}{100}$ , rarely fails to give very speedy relief. In a chronic disease such as asthma, morphia should be withheld if possible, but for an acute emergency it is invaluable.

Spraying the nasal mucous membrane with a two per cent solution of cocaine sometimes gives almost instantaneous relief.

A mixed vaccine prepared from organisms found in the asthmatic sputum has been tried in numerous cases, with some benefit, but it is too early yet to estimate the real value of vaccine therapy in asthma.

Tincture of stramonium  $\mathfrak{m}\times$ , with potassium iodide gr. v, three times daily, frequently gives great relief, and is very useful for the subacute dyspnoea which often persists between the severe attacks.

### 3. ACUTE BRONCHITIS

This may be met with as a primary affection or as a complication of other diseases, such as measles, typhoid fever, and influenza.

In elderly people and in young children it is a serious condition, and in a severe attack the patient should be confined to bed. The temperature of the room should not be too high, 60°–65° F. being a suitable range. A light flannel nightgown should be worn, and a gamgee-tissue jacket is very useful, especially as the patient commonly breathes more easily when sitting up.

The breathing is considerably relieved if the air is moist, and a bronchitis-kettle is therefore advisable. The head of the bed may be surrounded by a screen, but it should not be covered in too closely. A linseed and mustard poultice may be applied to the back with advantage, and over the front of the chest if there is much substernal soreness. Poultices should not be applied to the front of the yielding chests of young children, as they impede respiration and increase the collapse of the base of the lungs. Instead of the poultice a mustard leaf may be applied to the base of each lung posteriorly, and one over the sternum.

In the early stage, with a painful dry cough, a dose of Dover's powder, gr. x, may be given to an adult, but its constipating effect must be guarded against by some suitable aperient. It is also usual to give a simple saline mixture.

When there is great dyspnoea, with numerous rhonchi, an asthmatic element is often present, and the iodide and stramonium mixture (p. 180) should be used.

With the development of free secretion from the bronchi the more stimulating expectorants may be given, such as ammonia and senega. For an infant of a year old, ammon. carb. gr.  $\frac{1}{2}$ , pot. bicarb. gr. ij, vini ipecac. ℥ij, syrapi tolutani ℥x, aq. carui ad ʒj, may be given every four hours. Young children do not expectorate, and if there is much secretion in the tubes an emetic will help to bring it up. A drachm of ipecacuanha wine should be given, but may have to be repeated.

In very severe cases inhalations of oxygen are very useful. Ammonia and ether, or hypodermic injections of strychnine, may be given every four hours. In bad cases in adults alcohol • should be given in the form of brandy or champagne.



## 4. BRONCHO-PNEUMONIA

The temperature of the room should be from 60° to 65° F. A bronchitis-kettle should be used. As the disease is apt to run a rather long course every effort must be made to maintain strength and nutrition. Food must be given every two or three hours: milk, eggs beaten up in milk, or albumen water, beef-tea, and broths; and if an infant refuses food it must be fed by a stomach tube. A mustard poultice or a mustard leaf may be applied to the base of the lungs behind, and this may be repeated, but with caution as the skin readily becomes very sore.

In severe cases with cyanosis, feeble pulse, distended right heart and râles all over both lungs, stimulants must be given freely in the form of brandy (half a teaspoonful in milk every two hours to an infant) or small doses of ammonia and senega. Inhalations of oxygen are also very valuable. A child may also with advantage be put into a hot bath to which two tablespoonfuls of mustard have been added, and cold water dashed over the head and shoulders; the deep inspirations which this causes help to open up the collapsed alveoli at the bases of the lungs. Strychnine may be given hypodermically, gr.  $\frac{1}{100}$ , every six hours.

Tepid sponging is very valuable for restlessness, and a cold pack for hyperpyrexia.

## 5. PNEUMONIA. See p. 104.

## 6. PLEURISY WITH EFFUSION

A pleural effusion demands immediate aspiration under a variety of circumstances.

(i) When the pleural cavity is full, as indicated by dullness up to the apex of the chest.

(ii) If œdema or consolidation develops in the other lung, as indicated by the presence of râles or of dullness with tubular breathing; or if fluid accumulates in the other pleura.

(iii) If the heart becomes seriously embarrassed, as indicated by a failing pulse, dyspnoea, lividity, and faintness.

(iv) When it occurs as a complication of disease elsewhere, such as nephritis.

*Paracentesis thoracis.* Though a very simple operation, this should never be regarded as a trifling matter, as a considerable number of cases are on record in which sudden death has occurred on aspiration of pleural effusions (and on exploratory puncture of lung) from vagus inhibition of the heart.

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The patient should not be allowed to sit up for the operation, but should be rolled partly over on to the unaffected side. A hypodermic syringe, and ether and adrenalin solution, should be at hand in case of syncope.

A convenient spot for the puncture is the sixth intercostal space in the posterior axillary line. The skin at and around the selected spot should be thoroughly cleansed or painted with tincture of iodine, and the instruments should be boiled for five minutes before use. Five minims of a 5 per cent solution of novocaine may be injected into the skin before the puncture is made.

The best way to make the puncture is to pinch the skin up and make a small stab with a scalpel; it is difficult to make a small incision with a knife, and the skin in this region is often very tough. The trocar and cannula should be of medium size; a fine one is apt to become blocked, and with a large one the fluid tends to escape too rapidly. The trocar and cannula should be carefully inserted through the skin incision, and the space between the ribs searched for; sometimes this is very narrow. The sensation experienced when the instrument enters the pleural cavity is unmistakable. The trocar should then be withdrawn and the cannula connected to the bottle, which has previously been partially exhausted of air.

The following points must then be attended to:—

(a) The fluid must be withdrawn *slowly*. This is very important. When a large amount of fluid is removed the conditions obtaining in the thorax undergo a marked readjustment. The heart and mediastinal tissues resume their normal position, the diaphragm rises, the parietes sink in and the lung expands. A rapid removal is apt to cause coughing, pain, and great distress.

(b) If coughing and pain occur, the flow of fluid should be stopped; after a moment or two it may be possible to continue.

(c) If the slightest sign of faintness occurs the cannula must be withdrawn at once, and hot brandy and water, or sal volatile, should be given. If the pulse is suddenly arrested, the most active steps must be taken; hypodermic injections of ether and of 3 or 4 minims of adrenalin solution (1 in 1,000) should be given at once, and artificial respiration should be performed. Unfortunately the cardiac inhibition is apt to be complete and permanent. In cases in which no recovery occurs after two or three minutes, direct cardiac massage is probably the only means of resuscitation (see p. 23).

(d) If the fluid ceases to flow freely, the blunt trocar may be

passed through the cannula, which occasionally gets blocked by lymph; but if the flow is still arrested it is not advisable to move the cannula about in the pleural cavity in an endeavour to remove the whole amount of fluid. What is left will probably be absorbed without difficulty.

(e) Having removed the cannula, the puncture should be sealed with cotton wool and collodion.

### 7. EMPYEMA

The treatment of empyema consists in the resection of a portion of rib and the drainage of the pleural cavity. As the administration of an anæsthetic to a patient with one pleura full of pus is a serious matter, it is wise to aspirate the pus as a preliminary measure and to resect the rib on the following day.

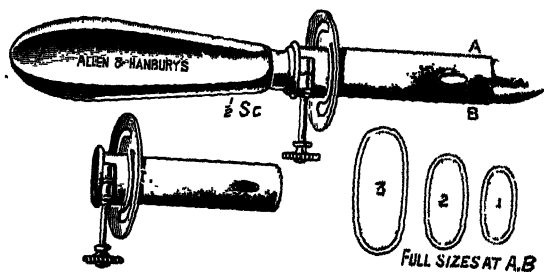


FIG. 42. Turner's empyema trocar.

When the breathing and the heart's action are much embarrassed owing to a large accumulation of pus in the pleural cavity, the risk of a general anæsthetic is largely increased, especially as the patient is obliged to lie upon the sound side during the operation, a position which still further interferes with respiration. This danger may be diminished by preliminary aspiration. But sometimes the pus is so full of curdy lymph that the cannula constantly gets blocked. In this case, in an adult, the skin may be rendered insensitve by the subcutaneous injection of novocaine and the remaining steps of the operation may be rendered comparatively painless by irrigating the wound from time to time with the same solution. We have found that the most painful part of the operation is the incision of the pleuro-periosteal layer after resection of the rib. The method of local anæsthesia described on p. 6 gives excellent results. Relief may be afforded much more rapidly by using Turner's empyema trocar (Fig. 42). An incision is made through the skin and intercostal muscle,

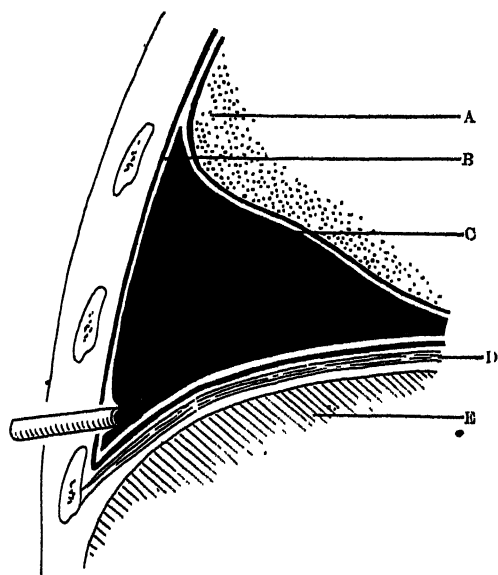


FIG. 43. Diagram of empyema before operation. A, Lung; B, Pleura; C, Pus; D, Diaphragm; E, Liver.

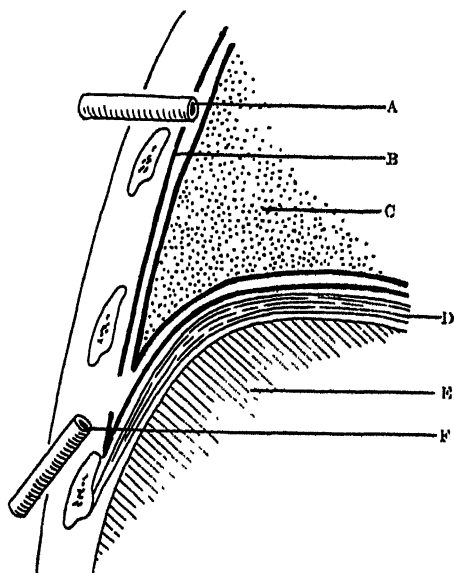


FIG. 44. Diagram of drainage tracks for empyema. A, Tube (correct position); B, Pleura; C, Lung; D, Diaphragm; E, Liver; F, Tube (incorrect position).

and the tube is pushed through into the pleural cavity in the same way as the ordinary trocar and cannula. The trocar is removed and the flat cannula left in position. In the course of a day or two resection of rib may be proceeded with.



FIG. 45. Operation of resection of rib for empyema.

The most suitable position for drainage lies in the posterior axillary line and near the *upper* level of the dull area. If too low a level is taken the diaphragm rises as soon as the fluid is evacuated, and tilts the inner end of the drainage tube upwards. A long oblique track is thereby produced which is unfavourable for drainage. This point is an important one, and is illustrated in Figs. 43 and 44.

*Operation for Empyema.* Fig. 45. An incision four inches long is made over and in the line of the rib to be resected,

and carried down at once to the bone. The periosteum is then stripped off with an elevator, carrying the intercostal vessels with it, and the exposed piece of rib, not less than three inches long in an adult, is removed with bone-cutting forceps. The pleura is then incised in the same direction as the wound, and the fluid allowed to escape slowly. The finger should be introduced gently, and any loose pieces of fibrin, such as are often present, removed, but no attempt must be made to break down adhesions. On no account must the cavity be irrigated with fluid. Many forms of drainage tube for empyema have been invented, such as the glass one shown in Fig. 46, but most are of far too small a bore and get choked at once; nothing is more satisfactory than an ordinary piece of rubber drainage tubing, stitched to the edge of the wound. It should be at least as large as the index-finger, should

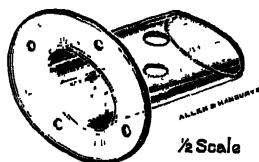


FIG. 46. Glass empyema tube.

have several large holes cut in its wall, and should only be long enough just to project beyond the chest-wall into the cavity.

*After-treatment.* The abscess cavity which constitutes an empyema depends for its obliteration chiefly upon the expansion of the lung. This can be materially assisted by causing the patient to perform exercises of forced expiration against a resistance, such as blowing into an air-bag. When drainage has been in progress for several days, and it is certain that no communication exists between the pleural cavity and the air-passages, much good can be done by causing the patient to lie in a boracic bath for half an hour or so daily. By this means the empyema cavity is rendered sweet, and toxic absorption is minimized. The cavity must not be irrigated, as numerous cases of sudden death have resulted from this practice.

## 8. PNEUMOTHORAX

The development of pneumothorax is often unrecognized. In the first place, if the pleuræ are adherent over a great portion of their surface, or if the lung is much consolidated, only a limited amount of air can escape, and shock may be slight or absent. In

the second place, even when a tuberculous focus in a comparatively healthy lung ruptures near the surface with severe pain and shock, the condition may be overlooked. The chest is resonant on percussion, and on auscultation the fact that breath-sounds are *absent* is unconsciously ignored, attention being directed to a search for *abnormal* sounds. Traumatic pneumothorax (p. 208) can hardly fail to be recognized.

When pneumothorax occurs in a patient with non-adherent pleura and comparatively healthy lung, the symptoms and physical signs are very characteristic. The onset is sudden, with severe pain in the chest; dyspnoea and shock are severe; the pulse may be extremely feeble and the extremities cold. A sudden drop in the temperature is common. These symptoms are materially lessened in the course of a few hours if the other lung is healthy.\* As a rule pleural effusion speedily follows the onset of the pneumothorax.

*Physical signs. Inspection.* The affected side is motionless, and the heart's apex may be seen displaced towards the left axilla, or pulsation may be visible to the right of the sternum, according as the pneumothorax is on the right or the left side.

*Palpation.* Vocal fremitus is absent.

*Percussion.* A hyper-resonant note is obtained. When fluid is present, the area of dullness at the base due to the pleural effusion undergoes marked change in position on altering the posture of the patient.

*Auscultation.* Breath sounds are diminished or absent; sometimes amphoric breathing is heard. The 'coin-sound' is characteristic, as also is the metallic tinkle produced when fluid drops from the upper part of the chest into the fluid at the base. A very characteristic sound is also produced by shaking the patient.

*Treatment.* In a case with marked shock and severe pain a hypodermic injection of morphia should be given at once. Stimulants should also be given, either by mouth or hypodermically.

If there is cyanosis and a very feeble pulse, the air should be let out from the pleura by means of a small trocar and cannula; if it collects again, the operation may have to be repeated.

The subsequent treatment depends on the nature of the case and whether pyo-pneumothorax develops. This is very common, and resection of rib should then be performed as for empyema.

## AFFECTIONS OF THE RESPIRATORY SYSTEM 189

### CONDITIONS ASSOCIATED WITH URGENT DYSPNŒA

It has been thought advisable to collect together into one section many of the conditions giving rise to urgent dyspnœa. The treatment of the apparently drowned is also included here, as although all respiratory movements have usually ceased, the effects are due to asphyxia from water entering the bronchi and lungs.

By the term dyspnœa is meant increased respiratory exertion produced either by some obstruction to breathing, or by interference with adequate aëration of the blood. Most of the conditions capable of giving rise to dyspnœa may at times give rise to respiratory distress of the greatest urgency. Some of these are susceptible of relief by medical or surgical means, whilst others are not. It is of the greatest importance, therefore, to distinguish between these two classes.

### METHOD OF INVESTIGATING A CASE OF URGENT DYSPNŒA

(a) *History.* A brief inquiry into the *history* of the case will often immediately indicate the cause of the dyspnœa, and suggest the proper line of treatment. A man, for example, who has for some weeks complained of hoarseness, alteration of voice, and cough, with purulent or blood-stained expectoration, is probably suffering from some form of laryngeal ulceration. A child who has been feverish and ill for two or three days, with gradually oncoming dyspnœa, may be suffering from diphtheria or retropharyngeal abscess, whereas a child previously quite well, and suddenly seized with symptoms of alarming dyspnœa coming on at night, apparently without cause, is probably affected with some form of laryngeal spasm. In the case of foreign bodies in the air-passages, and of scalds of the throat, the history is generally clear. If a history of symptoms pointing to intrathoracic disease is given, one would be on one's guard against performing an unnecessary and useless tracheotomy.

(b) *Stridor.* It is most important to notice whether or not stridor is present. Stridor indicates clearly the existence of some form of obstruction in the larynx, trachea, or a large bronchus, and its degree is some measure of the severity of that obstruction. It thus distinguishes at once obstructive dyspnœa from that due to imperfect respiratory interchanges in cardiac, pulmonary, and cerebral disease. Stridor is most marked during inspiration; the breathing is noisy and harsh, or may have



a musical or crowing character. It is to be distinguished from *wheezing*, in which the breathing is also audible but does not possess the harsh and noisy character of stridor. Wheezing is characteristic of obstruction in the finer bronchi, such as occurs in asthma.

(c) The *respiratory movements* are to be carefully noted. They are often slower than normal, a quick shallow inspiration not being powerful enough to overcome obstruction. They are also exaggerated, the accessory muscles being brought into powerful action. With severe obstruction the lower ribs are retracted, the epigastrium sinks in, and the supra-clavicular fossæ are rendered deeper at each inspiration.

It is to be borne in mind that broncho-pneumonia with collapse of the lower lobes in children may be attended with severe retraction of the ribs, and this has led to the unnecessary performance of tracheotomy. This error is to be avoided by noting the fact that there is no accompanying stridor.

(d) *Facies*. With severe respiratory obstruction there is an appearance of extreme distress, and the face is often covered with perspiration. The *colour* of the face should be observed, for although of itself cyanosis does not give much information, yet, in conjunction with other symptoms, its depth is a guide to the necessity for operative interference.

(e) *Pulse*. The *pulse* is of the greatest importance, low tension, irregularity, and increased rapidity indicating a degree of exhaustion which may not be recovered from even if proper respiratory interchange can be restored.

(f) *Examination of the throat*. In a case of urgent dyspnoea in a child, when the cause of the obstruction is doubtful, the throat should be inspected, and, if necessary, a digital examination of the air-passages made, as far as they can be reached. In this way a retropharyngeal abscess will not be mistaken for diphtheria, and a foreign body may be detected and removed; or an effort of vomiting may be brought on sufficient to expel a foreign body. But these manipulations should not be done until preparations are made for tracheotomy, as they sometimes induce a more severe dyspnoic attack, which might prove fatal.

#### INDICATIONS FOR IMMEDIATE TRACHEOTOMY

It may happen that, when the patient is first seen, the symptoms are of extreme urgency. The symptoms which would in such a case demand instant tracheotomy are as follows : dyspnoea

of *sudden* or *rapid* onset accompanied by extreme *stridor*, *cyanosis*, *violent respiratory efforts*, and *distress*, more particularly when attended by signs of *cardiac exhaustion*. In such cases tracheotomy should be performed at once, even though it may subsequently be found to have been useless owing to the position and nature of the obstruction. Such an event must be very rare, and its possibility should not deter one from operating when the urgency of the symptoms demands it.

#### MANAGEMENT OF THE LESS URGENT CASES

When cyanosis is not extreme, stridor of only moderate degree, distress not severe, retraction of chest not excessive, and pulse strong and regular, the examination may be made more in detail, and the above-mentioned possible source of error\* can and must be eliminated. If the case is an obstructive one, the preparations for operation can be properly made, and the procedure of choice can be performed deliberately and without the haste that is sometimes bred of panic.

The cases fall naturally into three main groups :

- I. Obstructive dyspnoea which can be relieved by surgical or medical means.
- II. Obstructive dyspnoea which cannot be so relieved.
- III. Non-obstructive dyspnoea.

#### I. OBSTRUCTIVE DYSPNOEA CAPABLE OF RELIEF BY SURGICAL MEANS

The causes are mainly laryngeal or tracheal. The method of investigation noted on p. 189 can be carried out more fully. The diagnosis of the nature and the site of the obstruction depends upon a full consideration of the history of the case, the physical signs present in the throat, larynx, and neck, and a general examination of the chest, abdomen, and urine.

The main lines of action in these cases are sufficiently simple in theory. They are :—

- (a) To remove the obstruction, or
- (b) If that is impossible, to make an opening\* into the air-passage below the site of obstruction, or
- (c) To introduce some form of tube into the air-passage past the obstruction.

The more common forms of respiratory obstruction will now be dealt with *seriatim*, with the exception of foreign bodies

which have been dealt with in Chapter IX, traumatic dyspnoea in Chapter XI, and respiratory obstruction during general anæsthesia in Chapter II.

### I. ŒDEMA OF THE LARYNX

This occurs under two main conditions :

- (i) Inflammatory affections from
  - (a) Scalds, burns, and corrosive poisons.
  - (b) Any form of laryngeal ulceration.
  - (c) Cellulitis of the neck. See p. 65.
  - (d) Presence of a foreign body.
- (ii) Non-inflammatory in
  - (a) Renal disease.
  - (b) \*Angio-neurotic œdema.
  - (c) After the administration of potassium iodide.

*Symptoms.* The patient usually complains of a feeling as if a foreign body were present in the throat and of difficulty or pain in swallowing. On attempting to swallow fluids there is a tendency for them to make their way into the larynx, with resulting fits of choking. The voice becomes husky and respiration difficult with gradually increasing stridor and there is usually an irritable cough.

On examination with the laryngoscope the epiglottis and the aryteno-epiglottic folds are greatly swollen, but the true cords are little affected owing to the more intimate attachment of the mucous membrane.

Some of the more important varieties will be considered in detail.

#### (i) *Inflammatory affections :*

(a) *Scalds, burns, and corrosive poisons.* A child who has scalded the throat, even if no symptoms whatever are present, should be put to bed, with a tent and steam-kettle, and carefully watched. An ice bag or Leiter's coil should be applied to the neck, and speaking forbidden. Should dyspnoea come on and become at all urgent, two courses are open, namely, intubation and tracheotomy. In such cases it is always worth while to try the former procedure, as the introduction of an intubation tube for only a few hours may tide the patient over the danger and obviate the necessity of a cutting operation ; but the surgeon should be prepared to perform tracheotomy as intubation may fail owing to the swelling enveloping the upper opening of the tube.

In the case of an adult a hypodermic injection of morphia should be given, the throat should be sprayed with adrenalin solution 1 in 2,000, and cold compresses applied externally. These measures may give relief, but, failing this, intubation or tracheotomy must be performed.

(b) *Laryngeal ulceration.* If ulceration of any variety whatever is present in the larynx, whether traumatic (injury by foreign bodies or following corrosive poisons), syphilitic, tuberculous, or malignant, *acute cedema* with urgent symptoms may arise at any moment. Cedema of the larynx may develop with extreme rapidity, and when the medical man arrives the patient may be *in extremis*. In such an event tracheotomy or laryngotomy should be performed without hesitation. Intubation is not to be recommended in these cases, lest fragments of growth or septic material should be detached and inhaled, or other damage done. Moreover, the tracheotomy might be useful either as a preliminary to treatment of the laryngeal disease, or as a permanent opening.

(ii) *Non-inflammatory cedema.* This may occur in renal disease, in angeo-neurotic cedema or rarely after the administration of potassium iodide, even in small doses. The cedema, especially in angeo-neurotic cases, may also involve the tongue. The measures recommended for scalds and burns of the throat (p. 192) may be tried, but if it develops with great rapidity intubation or tracheotomy may be necessary. Owing to its tendency to recur with some frequency in angeo-neurotic cedema, it may be necessary for a tracheotomy tube to be worn constantly.

## 2. RETROPHARYNGEAL ABSCESS

This condition has been described in dealing with abscess in special regions (p. 62). As a cause of dyspnoea in children it is not an uncommon condition, and may readily be mistaken for diphtheria by the careless. A digital examination of the pharynx will readily decide the diagnosis, when a soft swelling can be felt bulging into the pharynx from its posterior wall. Tracheotomy is to be avoided in these cases, evacuation of the pus affording relief to the dyspnoea. For treatment, see p. 62.

## 3. LARYNGEAL GROWTHS

Benign or malignant tumours may arise within the larynx, and malignant growths may invade the larynx from neighbouring regions, such as the pharynx or thyroid gland. In children, particularly of the hospital class, papillomata of the larynx may be unsuspected until the patient is suddenly seized

with dyspnoea, due to the mechanical obstruction or to oedema or laryngeal spasm resulting from their presence. Such a case will probably require tracheotomy to relieve the urgent symptoms, and subsequent removal of the growths. But if a patient is known to have laryngeal papillomata, and the dyspnoea is not urgent, an attempt may sometimes be made to relieve the symptoms by intra-laryngeal removal with forceps, or intubation may be tried. As any such manipulation may induce severe dyspnoea, the surgeon must be prepared to perform immediate tracheotomy.

In cases of malignant disease, laryngotomy should be proceeded with at once, and the opening will have to remain permanently.

Urgent dyspnoea due to pressure of growths or enlarged glands either upon the larynx or trachea may be relieved by using a catheter in the same manner as an intubation tube. The gum-elastic catheter is the best for this purpose, and, in sudden emergency, is usually more readily available than either the intubation or tracheotomy instruments.

#### 4. DYSPNOEA CONNECTED WITH GOITRE

Dyspnoea is one of the most important symptoms of goitre and arises in various ways :—

1. *Direct pressure on the trachea.* This is the commonest and most important. The trachea is nearly always compressed laterally, and when the enlargement affects one lobe more than the other it is flattened on that side and pushed over towards the opposite side. The following points of importance to be noticed :—

(i) In some cases the pressure is produced by a portion of the enlarged thyroid being substernal in position. Pressure is thus easily produced, and, owing to the goitre in the neck being sometimes of insignificant size, the nature of the case has been overlooked, the patient being treated for asthma. The neck should be carefully examined. Percussion over the sternum may yield a dull note.

(ii) The dyspnoea may be paroxysmal in character. This may be due to :—

(a) Alteration of position of the neck with increase in the pressure, which may occur during sleep.

(b) Transient swelling of the goitre. Goitres are apt to vary in size, especially during the menstrual period.

(c) Hæmorrhage into a cystic portion of the goitre. This has produced sudden and rapidly fatal dyspnoea.

(d) Exertion, the narrowed trachea not allowing the passage of the extra flow of air required.

2. *By pressure on the recurrent laryngeal nerves.* Such pressure can produce paralysis of the abductor muscles of the larynx with resultant adductor approximation of the cords (p. 196). It is probable also that some paroxysmal attacks of dyspnoea are due to transient adductor spasm.

*Treatment.* (i) In cases in which some degree of stridor is always present it should be borne in mind that the obstruction may increase rapidly or suddenly. A preliminary course of thyroid treatment, gr. iij of the thyroid powder three times daily

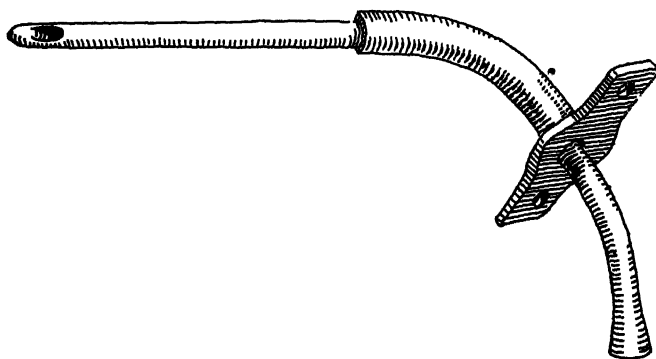


FIG. 47. Catheter threaded through tracheal tube.

should be tried, *provided that the case is not one of exophthalmic goitre*. If this produces no relief, the case should be treated surgically, a sufficient amount of the goitre being removed to relieve the obstruction.

(ii) If the patient is seen in a paroxysm of acute dyspnoea the position of the neck should be altered. Sometimes this is sufficient to give relief. Failing relief, intubation by means of a gum-elastic catheter should be tried, and, if possible, should be preferred to tracheotomy, an operation which, on account of the distortion and depth of the trachea and the amount of bleeding which is apt to occur, may be a most formidable undertaking.

If tracheotomy is necessary it will be found that the ordinary tube is too short to get past the obstruction. To overcome this difficulty there is a specially constructed long tube, made of flexible wire (König's tube, Fig. 52), but as this is not likely to be available in case of emergency, a large soft rubber catheter, threaded through an ordinary rubber tracheotomy tube (Fig. 47), answers the purpose admirably.

*Note.* After operation upon the thyroid the respiration may be affected, the dyspnoea being due either to an obstructive or a toxic cause. The obstruction may be laryngeal from injury to the recurrent nerves, or tracheal from flexion of the weakened trachea. The depth and distortion of the trachea may make tracheotomy extremely difficult, nor would an ordinary tracheotomy tube be long enough to enter the windpipe and afford relief. If possible, therefore, tracheotomy should be avoided by the use of a catheter passed through the mouth and larynx into the trachea.

## 5. PARALYSIS AND SPASM OF LARYNGEAL MUSCLES

### (a) *Abductor paralysis*

*Unilateral abductor paralysis* does not produce much dyspnoea. The affected cord lies in the middle line owing to the unopposed action of the adductor muscles. The air-passage is reduced by one-half, but dyspnoea only occurs on exertion. The commonest cause is compression of the recurrent laryngeal nerve in the thorax by aneurysm or by enlarged glands, tuberculous or malignant.

*Bilateral abductor paralysis* is much more important, inasmuch as the cords are not abducted on inspiration, but are actually drawn closer together. There is therefore definite inspiratory stridor. The voice is unaffected. The commonest causes are locomotor ataxy, general paralysis, and disease of the bulbar nuclei. The dyspnoea is apt to be increased by paroxysmal spasm of the adductor muscles, or by even the slightest laryngitis.

*Treatment.* In bilateral abductor paralysis tracheotomy should be performed. A plug can be worn in the tube, which can be removed if necessity arises.

### (b) *Spasm of laryngeal muscles*

Nerve irritation, whether central, peripheral, or reflex, can give rise to spasm of the glottis. The two following are the more common types:—

(i) *Laryngeal crisis in locomotor ataxy.* Sudden paroxysmal attacks occur with noisy stridor, both inspiratory and expiratory, which may last for some hours.

*Treatment.* The spasm is usually promptly relieved by inhalation of amyl nitrite. Chloroform is also useful in some cases.

(ii) *Laryngismus stridulus.* This commonly occurs in rickety children. Breathing is suddenly arrested, and the child turns blue

in the face ; the spasm then relaxes and is followed by a crowing inspiration. The attacks may recur frequently and are occasionally fatal.

The *diagnosis* rests on the suddenness and transient character of the attacks. In the intervals there is no cough or difficulty of breathing. In whooping-cough there is a series of coughs followed by crowing inspiration.

*Treatment.* The child should be put into a hot bath and cold water poured over its head. The epiglottis may be hooked forwards with the finger with immediate relief. Inhalations of amyl nitrite or of chloroform can be tried, but owing to the spasm of the glottis they are not of much avail. If the child ceases to struggle for breath and the pupils dilate, artificial respiration should be immediately employed.

After the attack is over the diet and general hygiene of the child should be carefully supervised.

### (c) *Catarrhal laryngeal spasm*

In this condition there is probably a combination of laryngitis and spasm. It is an affection of childhood and commonly occurs at night. The child wakes up with some dyspnoea, huskiness of voice, and a harsh croupy cough ; this lasts for an hour or two and then subsides. It may be repeated for several nights.

The *diagnosis* rests on the fact that the attack develops very rapidly in a child previously well and that there is commonly a history of preceding attacks. It must never be forgotten, however, that in all cases of dyspnoea in children the throat should be thoroughly inspected for the presence of diphtheritic membrane.

*Treatment.* The child should be put in a hot bath whilst a large linseed poultice is being prepared. This should be placed over the front of the neck from the chin to the top of the sternum. A steam-kettle should be used in the room, the nozzle being placed so that the steam passes freely over the cot. One or two grains of calomel should be given every three hours until the bowels have acted freely, and ipecacuanha wine in drachm doses may be given every quarter of an hour until vomiting occurs.

After the attack is over the throat should be examined for the presence of enlarged tonsils and adenoids, and, if present, these should be removed. The general conditions of the child's life should be carefully inquired into and rectified if faulty.



## II. OBSTRUCTIVE DYSPNŒA INCAPABLE OF SURGICAL RELIEF

The chief causes are pressure on the lowest part of the trachea or on its bifurcation by aneurysm, mediastinal growths, or tuberculous glands; syphilitic stenosis of the lower part of the trachea is a rarer cause. The diagnosis rarely presents any difficulty. Laryngoscopic examination reveals the absence of laryngeal obstruction. There is nothing in the neck to cause pressure on the trachea, and symptoms indicative of intra-thoracic disease, such as a pulsating tumour, dullness on percussion, engorged veins of head and neck, pleural effusion, and diminution of air entry into one or both lungs are present. A brassy cough is common.

*Treatment.* In cases due to pressure by aneurysm or growth, treatment must be purely symptomatic. In aneurysm of the transverse arch the dyspnœa may be constant, but with paroxysmal increases in severity. The only sources of relief are venesection, chloroform inhalation, and morphia. Morphia should be given freely as the distress is extreme. Potassium iodide has given some relief in syphilitic cases.

## III. NON-OBSTRUCTIVE DYSPNŒA

It is not difficult to distinguish a non-obstructive case of dyspnœa from an obstructive one. In the former the absence of stridor is the most striking feature, and there are at the same time positive signs of pulmonary, cardiac, or cerebral disease, or of injury to the chest or head. The routine physical examination for disease of the heart and lungs, and for nephritis and diabetes, will readily bring to light the cause of the dyspnœa. The treatment of these conditions will be found under their respective headings.

### THE OPERATIONS OF INTUBATION, LARYNGOTOMY, AND TRACHEOTOMY

#### I. INTUBATION

O'Dwyer's intubation apparatus, as held when about to be used, is shown in Fig. 48. The easiest way to perform the operation is to have the child held in a sitting posture by a nurse,

facing a good light, and with its arms enveloped in a towel to prevent struggling. An assistant holds the mouth open with a gag and steadies the head. An introducer, carrying an intubation tube of suitable size, is then taken in the right hand, whilst the left index-finger feels for the upper aperture of the larynx and guides the tube over the back of the tongue and epiglottis into the larynx. Unless the tube is kept close to the back of the tongue it is easy for it to slip into the pharynx behind the larynx, instead of into the larynx itself. The introducer is then withdrawn, and the silk threads attached to the tube are secured to the cheek with a piece of strapping. The tube should not be allowed to remain in too long, lest it cause ulceration of the

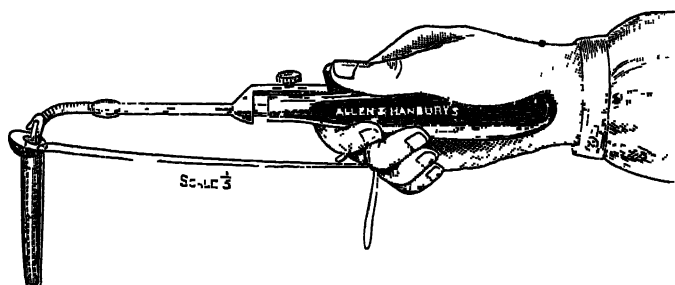


FIG. 48.

mucous membrane of the larynx. If, after twelve hours or so, severe dyspnœa is still present on withdrawing the tube, tracheotomy should be performed.

In case of sudden emergency, when neither intubation tubes nor tracheotomy instruments are available, temporary relief can be afforded by means of a gum-elastic catheter, introduced in exactly the same manner, passed over the back of the tongue and guided into the larynx by the left forefinger.

## 2. LARYNGOTOMY

This is the operation of opening the air-passage immediately below the larynx, that is to say, through the crico-thyroid membrane (Fig. 49). It is a simple procedure which, in an emergency, can be performed with a pocket-knife.

*Operation.* The interval between the cricoid and thyroid cartilages must be identified, and a small vertical incision made over it, exactly in the mid-line. The hæmorrhage is trifling as a rule. The crico-thyroid membrane is then seen, and is incised

transversely, thus opening the air-passage. The laryngotomy tube can now be introduced, no dilator being required, as the wound in the membrane gapes widely. A laryngotomy tube is distinguished from a tracheotomy tube by being flattened from before backwards, so as to be oval instead of circular in section.

Laryngotomy is only to be used as a very temporary measure, the proximity of the tube to the vocal cords rendering any prolonged retention liable to be followed by serious damage.

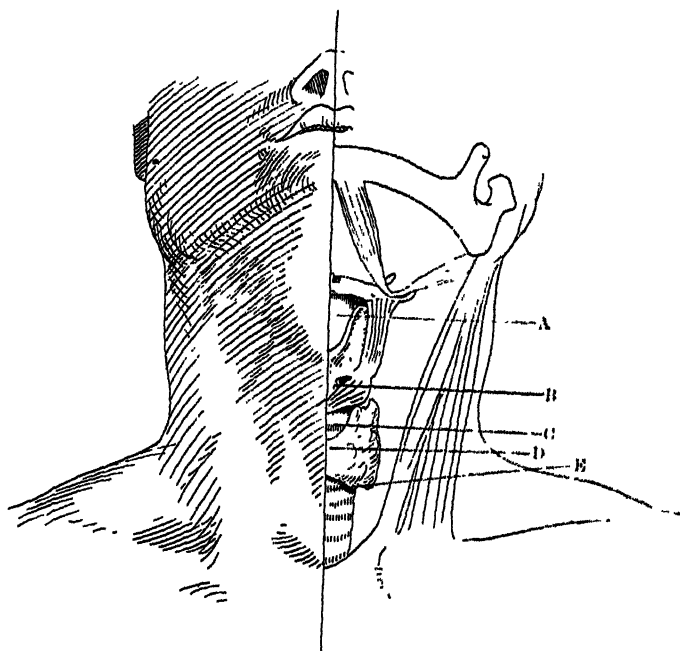


FIG. 49. A, Thyro-hyoid membrane; B, Crico-thyroid membrane (laryngotomy); C, Trachea (high tracheotomy); D, Thyroid isthmus; E, Trachea (low tracheotomy).

### 3. TRACHEOTOMY

This operation involves the opening of the trachea below the cricoid cartilage. It is spoken of as 'high' or 'low', according to whether the tracheal incision is made above or below the isthmus of the thyroid gland. This distinction is found, in practice, and particularly where children are concerned, to be of little importance. In point of fact the thyroid isthmus is not infrequently divided during the operation, a circumstance which

is attended by no evil results. If the isthmus is encountered, and its retraction would in any way impede the full and proper view of the trachea, it should be divided without hesitation, the incision through it being made vertically in the mid-line. It is almost always better to make the tracheal opening as low as possible (see p. 101).

*Operation.* The head is to be thrown well back, the shoulders being supported upon a firm sand-bag. (Fig. 50.) The cricoid cartilage should then be identified, and this can readily be done even in the fattest neck, if the finger is passed upwards

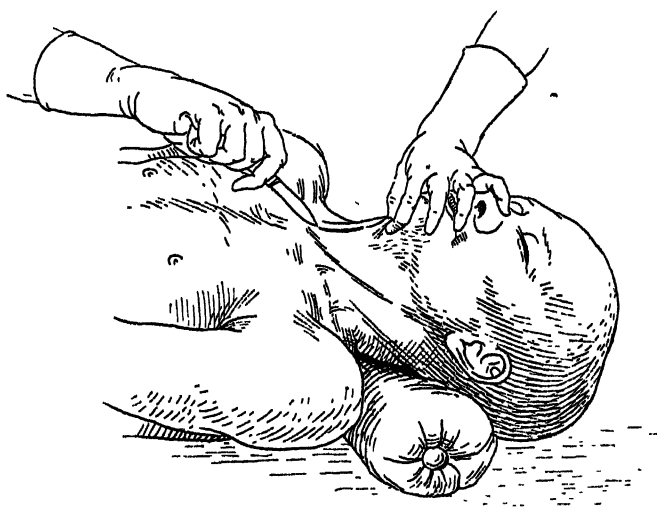


FIG 50. Position for tracheotomy.

along the mid-line of the neck from the suprasternal notch. The surgeon, standing to the right of the patient, makes an incision reaching from the cricoid cartilage as far as the upper border of the sternum. In an adult, the incision need not be taken so far downwards, as the trachea is longer and more accessible than in a child. It should be remembered that most of the difficulties and accidents of tracheotomy, particularly in young children, arise from making too small a skin incision. A combination of skill and luck sometimes enables an operator to perform what is known as a 'button-hole tracheotomy', but it is wiser to err on the side of too large rather than of too small an incision.

The next step is the division of the deep fascia, also exactly

in the mid-line, and the separation of the infrahyoid muscles and anterior jugular veins. Once the deep fascia has been divided, the separation of the muscles is best accomplished by means of retractors, as this produces less bleeding. The thyroid isthmus is thus exposed, and it may either be retracted upwards or divided, so as to expose the trachea, which should always be

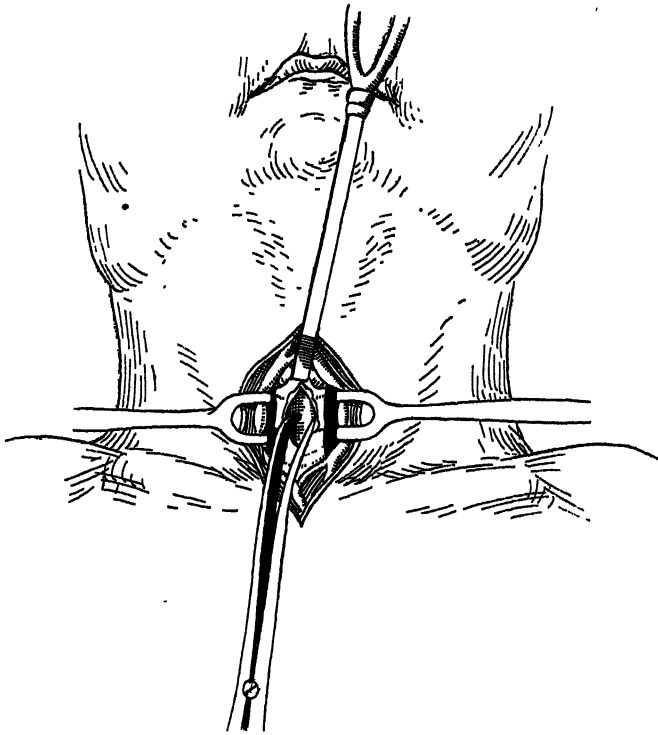


FIG. 51. Low tracheotomy.

clearly seen before it is incised. Unless this is done, veins will almost inevitably be divided at the moment the trachea is opened: the patient takes a deep breath and blood is sucked into the lungs, with the result that either the patient is literally drowned in his own blood (as we have actually seen happen) or subsequently develops broncho-pneumonia. It is best at this stage to tie off all bleeding-points, and render the wound thoroughly dry. The knife is next taken pen-wise between the forefinger and thumb, so as to leave exposed only about a quarter

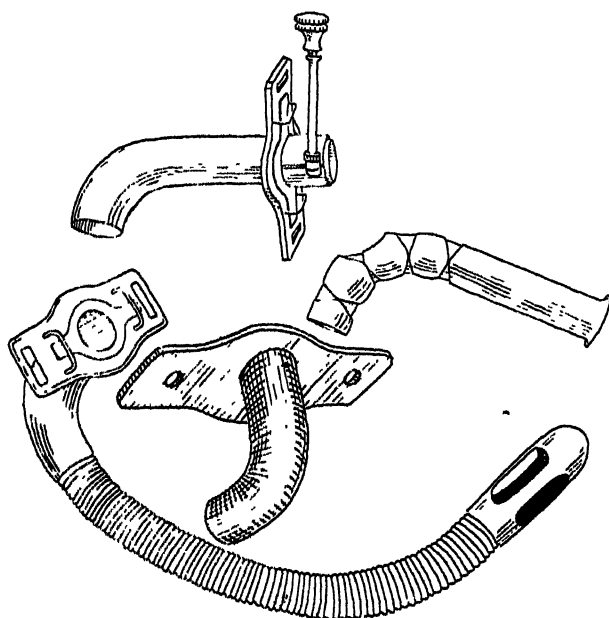


FIG. 52. Silver tracheal tube with inner tube, rubber tracheal tube, and König's tube.

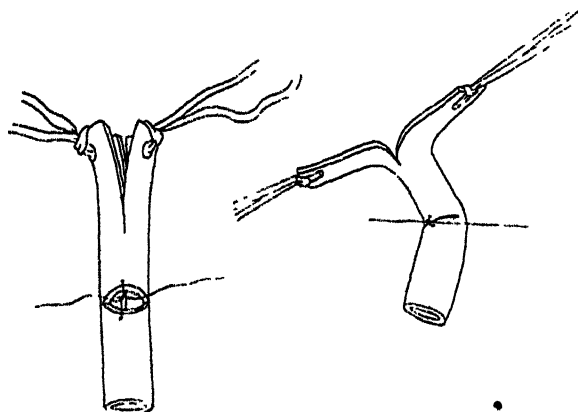


FIG. 53. Emergency tracheal tube fashioned from a piece of rubber drainage tube.

of an inch of the blade, and is entered at the lowest point of the proposed incision, and carried upwards towards, and if necessary dividing, the cricoid cartilage. The tracheal opening should

always be sufficiently large to admit the tube quite easily. The incision is now held open with the dilators (Fig. 51), until the coughing which the opening of the air-passage always evokes has subsided, and until the air entry is seen to be efficient, after which the silver tube is introduced. A stitch or two may be placed in the skin, but it is best not to close the wound too securely around the tube in case it should be coughed out and need replacing. Moreover, if the skin wound is tightly closed, subcutaneous emphysema may occur. The metal tube should be replaced by a rubber one (Fig. 52) on the second day, if it cannot be left out altogether, as otherwise tracheal ulceration may be produced. There are many forms of tracheotomy tube, all of which have their advocates, but there is little doubt that the one most generally useful is that known as the 'lobster-tail' (Fig. 52).

In an emergency, a serviceable tracheotomy tube can readily be fashioned from an ordinary piece of drainage tubing (Fig. 53).

#### TREATMENT OF THE APPARENTLY DROWNED

In some cases immersion is due to a fall into the water from a syncopal attack, or from cerebral hæmorrhage, or the patient may receive a severe injury to the head in the act of falling. Immersion, therefore, may be only one aspect of the case.

*Treatment.* The mouth, pharynx, and nostrils should be cleared of any weeds or sand that may have entered them. Artificial respiration should be commenced at once; Silvester's method is described on p. 20. Schäfer's method is preferable, as it allows water to escape from the mouth more readily, and by its action in producing upward pressure on the diaphragm exerts a valuable stimulating effect on the heart. It should be performed as follows: lay the patient face downwards on the ground and kneel across his body, with the hands on his lower ribs. Allow the weight of the body to fall gradually so as to produce firm pressure on the patient's chest (Fig. 54, A). Then, with the hands remaining in position, raise the body, slowly relieving the pressure (Fig. 54, B). These movements must be repeated about fifteen times a minute, they must be continued for at least half an hour in the absence of any sign of restoration of breathing, and they should not be immediately given up at the first gasp the patient takes.

Warmth is most important. Whilst the artificial respiration

is in progress an assistant should remove the wet clothes, and the patient should be wrapped up in hot blankets, and hot-water bottles or hot bricks covered with flannel applied to the limbs. As soon as natural respiration is restored every effort must be



A



B

FIG. 54. Schüfer's method of artificial respiration. A, Expiratory phase; B, Inspiratory phase.

directed to keeping the patient warm; friction of the limbs should be applied. Stimulants, such as hot brandy or hot coffee, ammonia, and ether, and hypodermic injections of strychnine should be given.



## CHAPTER XI

### INJURIES OF THE CHEST

THE thorax and its contents may suffer injuries of almost endless variety from the same kinds of accident as affect the abdomen, namely, severe blows, crushes, violent flexion and extension of the trunk, and penetrating wounds. Just as the abdominal viscera may be lacerated by fractured ribs without external wound, so also may the thoracic viscera. It cannot be too strongly emphasized that, as a large and important part of the abdominal contents lies under shelter of the ribs, especially posteriorly and laterally, the possibility of simultaneous abdominal injury must always be borne in mind. Contusions of the chest are often accompanied, quite apart from gross injury of either abdominal or thoracic organs, by severe symptoms of shock. The shock may be out of all apparent proportion to the severity of the injury, and may even prove fatal with little or no post-mortem evidence of injury. The symptoms commonly met with in contusions and wounds of the chest are, firstly shock; secondly dyspnoea, cyanosis, hæmoptysis, and rapid shallow respiration; and thirdly physical signs of hæmothorax, pneumothorax, and emphysema.

Many thoracic injuries are immediately or speedily fatal, whilst others are of such rarity that the discussion of them would serve no useful purpose. Attention will therefore be directed to the diagnosis and treatment only of such thoracic injuries as are of frequent or fairly common occurrence, or are amenable to surgical treatment.

#### I. CONTUSIONS

##### METHOD OF EXAMINATION

(a) A preliminary examination should be made of the *abdomen*, as indicated in Chapter XV, because the upper abdominal viscera, being largely under shelter of the ribs, are liable to injury in crushes of the chest. Lacerations of the liver, spleen, and kidneys in particular, are apt to be associated with fractures of the ribs, as also are rupture of the stomach and intestines, penetration of the stomach by a fractured rib, and rupture of the

diaphragm. A good example of combined thoracic and abdominal injury has been reported by Roughton. A shunter, 49 years of age, sustained a buffer accident. The seventh and eighth ribs on the left side were fractured. On the following day the abdomen appeared normal, but the left side of the chest was distended, and its movements impaired. Cardiac dullness was absent. The left lung showed physical signs of compression in the upper part of the chest, whilst below that was an area of hyper-resonance, giving the bell-sound on auscultation. The diagnosis of ruptured diaphragm was made, operation performed, and the stomach withdrawn from the pleural cavity, into which it had become herniated. The patient, however, died, and at the autopsy it was found that the diaphragm had been torn away from its attachment between the ninth rib and the ensiform cartilage, whilst the spleen had been torn and lay in the pleural cavity.

(b) When the nature of the accident suggests the possibility of injury to the *spine*, careful examination for signs of such an injury should be made, as the presence of any fracture of the spine or any symptoms pointing to damage of the spinal cord would call, not only for its appropriate treatment, but also for the exercise of the greatest care in moving the patient whilst examining the thorax. Deformity and local tenderness of the spine should be looked for, as well as paralysis of the legs or any other obvious signs of cord injury.

(c) Ascertain by palpation whether any ribs are fractured. The signs of fractured rib are acute local tenderness; increased pain on attempting to take a deep breath; and crepitus, which may either be felt or may be heard with the aid of a stethoscope.

(d) Examine by palpation for the presence of surgical emphysema. The presence of air in the subcutaneous tissues is manifested by the appearance of a soft 'doughy' swelling, conveying to the fingers a sensation of fine crackling which is quite characteristic. This condition of surgical emphysema may spread with incredible rapidity, so as to extend, in a very short time, over the greater part of the body.

(e) Evidence of contusion or laceration of the lungs must be sought for. The lung may be merely *contused*; no hæemothorax or pneumothorax occurs, the patient coughs up a little blood, a little pleural friction commonly develops, and the patient speedily recovers. On the other hand the lung may be *lacerated*, in which case the expectoration is blood-stained and frothy, or larger quantities of blood are coughed up, whilst it is usual for pneumothorax or hæemothorax, or both, to occur.

(i) *Pneumothorax*. Owing to the fact that pneumothorax in itself gives rise to great pain and shock, the symptoms of onset in the traumatic cases are particularly severe, as they are added to those of the injury. Severe pain is felt in the chest, dyspnoea is intense, respiration is frequent and shallow, cyanosis is common, the extremities become cold, and syncope may occur. The greater the rapidity with which the air finds its way from the lung into the pleural cavity the greater is the severity of the symptoms. The acuteness of the symptoms diminishes in a few hours as the unaffected lung and the displaced heart adjust themselves to the new conditions. For the physical signs of pneumothorax see p. 188.

(ii) *Hæmothorax*. Hæmothorax rarely occurs alone as the result of a chest injury. The patient exhibits all the signs of severe shock, for loss of blood is added to the other effects of the injury. The blood is derived either from the lung, or from a parietal vessel such as an intercostal or internal mammary artery. The physical signs are those of a rapidly developing pleural effusion. There is dullness on percussion over the lower part of the affected side, with absence of breath sounds and diminution or absence of vocal fremitus and vocal resonance.

(iii) *Pneumothorax and hæmothorax combined*. It is more common for both these conditions to be present together than for one alone. The blood collects at the base of the chest and gives the ordinary signs of pleural effusion. Above the level of the blood the physical signs of pneumothorax are obtained. In addition, the note changes on movement of the patient, owing to the blood being able to move freely in the air-containing cavity. During such movement a splashing sound may be heard, but it is not wise to shake the patient in order to elicit this.

#### TREATMENT OF THORACIC CONTUSIONS

1. *Fractured ribs*. Ribs are fractured either by direct violence, or by a compressing force which approximates their vertebral and sternal ends. In the former the broken ends are liable to be driven inwards; in the latter, outwards. Consequently fractures from direct violence are more likely to be complicated by injury to the subjacent viscera.

The fracture of two or three ribs without visceral complication is, in the young and healthy, an accident of no great importance. No special treatment is requisite beyond rest in bed for a few days, together with bandaging or strapping of the chest. (Fig. 55.)

The object of strapping is to limit the movements of the broken ribs. The strips of strapping, which should extend from the spine to the sternum, must therefore be applied when the chest is in the position of expiration.

In the aged, the obese, the alcoholic, and the subjects of visceral disease, on the other hand, the fracture of even a single rib is a serious accident, and is attended with grave risk of pulmonary complications. Such persons are best kept at rest in bed propped up in a sitting posture, and the treatment must be stimulating and symptomatic. If many ribs are broken there may be considerable respiratory embarrassment and cyanosis, and when this is the case, venesection will be found to afford very great relief, from ten to thirty ounces of blood being withdrawn.

*Operation of venesection.* A bandage is to be applied to the upper arm sufficiently tightly to obstruct the venous but not the arterial circulation. The skin over the front of the elbow must be thoroughly cleansed, and the most prominent vein, usually the median basilic, should be opened by thrusting a sharp knife into it, and cutting outwards through the skin, the side of the blade being kept parallel to the skin surface.

The blood is received into a basin, and the amount removed must be sufficient to give relief without causing faintness. During the operation the patient must sit upright in order that any tendency to syncope may be at once detected. The rate of blood-flow can be increased, if so desired, by the time-honoured device of making the patient rhythmically compress an object such as a rolled-up bandage in his hand. When sufficient blood has been abstracted, the bandage must be removed from the upper arm, and the little wound dressed with a firm pad of gauze.

2. *Subcutaneous emphysema.* This is only of importance as an indication of a wound of the lung. It is easily recognized, and calls for no treatment beyond that required for the fractured

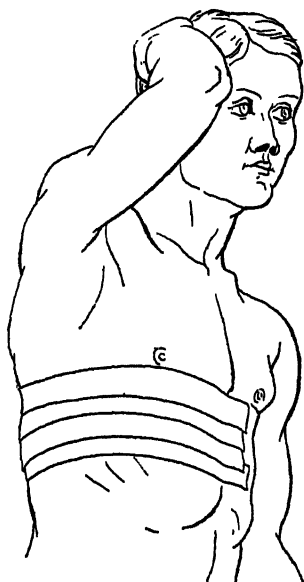


FIG. 55. Method of strapping the chest for fractured ribs.

ribs that have caused it. It will, if the patient recovers, subside spontaneously. Attempts to relieve it by multiple punctures through the skin are unnecessary, futile, and not devoid of danger.

3. *Contusion and laceration of lung.* Unless accompanied by hæmothorax or pneumothorax of a severe degree, or followed by empyema, there is little that can be done beyond absolute rest, applying an ice-bag to the chest, and giving morphia subcutaneously (see Hæmoptysis, p. 35). Such injuries, unless severe enough to be rapidly fatal, are, as a rule, readily recovered from. The outlook is of course grave in old people, and in the subjects of alcoholism and visceral disease.

4. *Pneumothorax.* A laceration of the pleural covering of the lung may be of such a nature that during expiration air enters the pleural cavity, but is unable to escape during inspiration. In these circumstances the pleural cavity rapidly becomes distended and the lung collapses, giving rise to severe respiratory distress. Relief is readily afforded by puncturing the chest-wall, as in paracentesis thoracis, with a trocar and cannula, when the air in the pleural cavity will escape and allow the lung to expand. The operation may have to be repeated. In the slighter degrees of traumatic pneumothorax, where there is no special embarrassment of respiration, it is best to take no active steps as the air will gradually be absorbed.

5. *Hæmothorax.* It rarely happens that hæmothorax is severe enough to require operation; in the slighter cases the blood is absorbed spontaneously. It is only when the amount is so large as to cause embarrassment of respiration or displacement of the heart that active surgical treatment is necessary. It sometimes happens that a small hæmorrhage into the pleural cavity is followed in the course of a day or two by the effusion of a large quantity of serous fluid (traumatic pleurisy); this may cause such respiratory and cardiac distress as to call for relief by aspiration. A hæmothorax resulting from laceration of the lung and visceral pleura should not be aspirated immediately, unless the dyspnœa is severe, because fresh hæmorrhage from the torn lung will probably be provoked. After a few days the operation may be done with impunity, but then will rarely be found to be necessary, as rapid absorption usually takes place.

If infection occurs, and an empyema results, drainage of the pleura is required.

## II. WOUNDS

Bullet wounds, stabs, compound fracture of ribs and such-like injuries may or may not cause penetration of the thoracic cavity.

The examination of the actual wound will raise the question as to whether or not a probe should be used to ascertain whether deep penetration has occurred. As a rule little or no information can be gained by probing, whilst the dangers of sepsis and of converting a non-penetrating into a penetrating wound are sufficient to forbid such an examination. The most reliable evidence of penetration is the presence of pneumothorax, hæmothorax, and hæmoptysis, and the same physical examination of the chest must therefore be made as described above for contusions.

As with contusions, so with penetrating wounds of the chest, the possibility of simultaneous injury of the abdominal contents must be borne in mind. A stab of any depth below the level of the fifth rib is almost certain to penetrate the diaphragm, and to be accompanied by simultaneous wounding of the upper abdominal organs, with extravasation and hæmorrhage, or by herniation of the abdominal contents through the diaphragm into the chest cavity.

In cases of bullet wound where the projectile remains lodged, accurate localization by means of the X-rays must be made, in order to come to a decision as to the advisability of immediate removal or not.

## TREATMENT OF WOUNDS OF THE CHEST

The majority of wounds made with high velocity bullets do best if left entirely alone, the points of entry and exit being cleansed and dressed aseptically. But in civil practice the injuries are usually more serious, inasmuch as, being caused by bullets of low velocity, more bruising and laceration of the soft parts, and splintering of bones, are caused, whilst the bullet may fail to gain an exit, and remain lodged in the thorax or abdomen. These wounds are also far more likely to be followed by septic complications, such as empyema. The chief points, in addition to the treatment of shock and the general management of the wound, to which attention has to be directed are:—

(i) *Hæmorrhage*. This may take place:—

(a) Externally, from an intercostal artery or from the lung. In the former case the blood escapes in jets corresponding to

the heart-beat ; in the latter it is forced out during expiration, and is frothy.

(b) Into the pleural cavity, either from the lung or a parietal vessel.

(c) Into the air-passages.

(a) With external hæmorrhage the wound must be enlarged by resecting portions of one or more ribs, as in the operation for empyema. If the hæmorrhage comes from a parietal vessel, a ligature must be applied ; if from a wound in the lung, the blood must be cleared out of the pleural cavity by mopping with dry gauze, the visceral pleura sutured to the parietal wound, and the tear in the lung plugged with sterilized gauze.

The treatment for internal pleural hæmorrhage (b) is that of hæmothorax (see below), whilst hæmoptysis (c) may be relieved by the general treatment of the wound above described, as well as by that appropriate in the case of spontaneous hæmoptysis (see p. 35).

(ii) *Hæmothorax and pneumothorax.* These are to be treated exactly as if they were present without external wound. A pneumothorax due to a parietal wound differs from one caused by subcutaneous rupture of the lung, in that the air gains admission during inspiration instead of expiration. In a slight case the wound should be made air-tight as speedily as possible, although in doing so there is some risk of causing subcutaneous emphysema ; in a severe case, the indication is to empty the pleural cavity of air and blood by resection of a piece of rib.

### III. INJURIES OF THE HEART AND PERICARDIUM

*Hæmopericardium and wounds of the heart.* Several cases of operation for wounds of the heart, with some successes, have been reported. A punctured wound over the cardiac area should be looked upon with suspicion, and if followed by an increasing area of dullness, with muffling of the cardiac sounds and increasing embarrassment of the heart's action, the possibility of surgical intervention should be considered. Rehns reported a case in which operation on the third day after a stab revealed the presence of a wound in the right ventricle  $1\frac{1}{2}$  centimetres in length, which he sutured with complete success. In this case the pleural cavity had also been penetrated, and contained a quantity of dark blood. If operation is undertaken for a wound of the heart, the method of approach would be by resection of the fifth left costal cartilage, as described below.

*Operations on the Pericardium*

Aspiration may be required to relieve a heart embarrassed by an accumulation of fluid, other than pus, in the pericardial cavity. Incision and drainage may be required for suppurative pericarditis and hæmopericardium.

(i) *Aspiration.* It is recommended by some that a trocar should be entered through a small incision close to the sternal edge, and immediately above the seventh left costal cartilage. This operation is by no means free from risk, as shown by reported cases of puncture of the heart itself, of wound and subsequent infection of the pleura, and of failure to find fluid although a large quantity may be present. We do not recommend it, on account of its dangers, and much prefer the epigastric or the open transcostal method, as described below.

(ii) *Drainage.* Either the epigastric or the transcostal route may be employed.

(a) *Epigastric.* An incision is made through the left rectus muscle immediately below the costal margin. After cutting through the transversalis fascia, the peritoneum is pushed downwards, and the finger is passed upwards through the diaphragm between its costal and ensiform attachments, until the base of the pericardium is reached. An opening is then made into the pericardial cavity, and a drainage tube introduced.

The advantage of this method is that it is free from the danger of wounding the pleura and heart, and at the same time provides a drainage point in a dependent position.

(b) *Transcostal.* This would also be applicable when it was desired to attempt closure of a wound of the heart, when the external wound would serve as a guide. An incision over and parallel with the sixth left costal cartilage is made, and the cartilage removed. If necessary the fifth and seventh may also be removed to give more room. The triangularis sterni muscle is next traversed, and the pleura pushed aside. The pericardium is then divided between two pairs of forceps, and the fluid allowed to escape slowly. A gauze wick is used for drainage, as a tube may press upon and interfere with the action of the heart.



## CHAPTER XII

### AFFECTIONS OF THE HEART AND VASCULAR SYSTEM

#### 1. SYNCOPAL ATTACKS

THE fundamental factor in the pathology of a fainting fit is a diminution in the volume of blood passing through the brain, though the resulting diminution of intracranial pressure may aid in producing the loss of consciousness. The causes of an attack are numerous. It may depend on cardiac disease; it is fairly common, as would be expected, in cases of severe chlorosis and in other forms of anæmia; with severe hæmorrhage; in conditions of exhaustion, especially when starvation is an added factor. Syncopal attacks frequently occur, however, apart from gross disease and may be precipitated by very different causes, such as sudden shock or excitement, the sight of a street accident, the sight of blood, a hot room, hunger, and so on. Many people are very prone to such attacks, and this tendency to faint on slight provocation is apt to run in families.

Physiologically two important factors are concerned: firstly, vaso-dilatation in the splanchnic area, and secondly, cardiac inhibition. It is probable that in some cases only one of these factors is primarily concerned; in others both may be involved. The fatal syncope which occasionally occurs when the lung is punctured by an exploring needle is doubtless due to reflex vagus cardiac inhibition (see p. 182).

The ordinary 'faint' is usually regarded as being a very trivial matter, but careful attention should always be paid to it as a serious error in diagnosis may easily be made, such as overlooking the real nature of the sudden unconsciousness in cases of heart block, the so-called Stokes-Adams syndrome (see p. 221), or of failing to recognize the existence of *petit mal*.

The onset of a fainting fit is usually gradual, with muscular weakness, a feeling of sinking in the epigastrium, increasing pallor, and dimness of vision. A period of insensibility then follows; the muscles are relaxed, the patient falls, consciousness is completely lost, the surface is pale and possibly cold and clammy; the eyes are closed and the pupils dilated; the pulse and heart-

sounds are nearly or quite imperceptible ; respiration is indistinguishable or occurs as occasional weak sighs.

This period lasts for a variable time and is followed by a gradual return of consciousness ; the pulse improves, the senses of sight and hearing can be excited, colour returns, and intelligence is restored.

A faint may be much more sudden than that described above, and with no premonitory symptoms. Recurring attacks of this description are strongly suggestive of *petit mal*.

*Treatment.* It is important to determine the cause underlying the fainting fit, as, if it is dependent on gross disease, efforts may subsequently be made to diminish the liability to attacks. Even in cases of simple fainting due to splanchnic instability the attacks may be lessened in frequency by judicious regulation of the patient's life.

In a mild attack the unconsciousness is very transient. The patient should be laid down flat on his back, friction applied to the limbs, and ammonia inhalations given. As soon as he can swallow, a dose of ammonia and ether, or of hot coffee, may be given.

When the attack occurs as the result of great exhaustion, the circulatory depression may be so great as to require very active treatment. When starvation is an added factor the risk to life is very great. The patient should be put to bed, wrapped up warmly, and hot-water bottles applied ; hot coffee may be injected *per rectum* ; if he can swallow, ammonia and ether or brandy should be given ; 20 minims of ether may be injected subcutaneously, and finally intravenous infusion of normal saline solution containing adrenalin may be used (see p. 12).

## 2. ACUTE PERICARDITIS

The most important and most frequent type is that due to the rheumatic infection. The utmost care should be taken, owing to the fact that the myocardium is affected at the same time, and the patient must, of course, be kept in bed. If the attack be associated with rheumatism, salicylates should be given. An ice-bag to the precordium frequently gives considerable relief to the pain. In a more severe case, with increasing effusion, three or four leeches may be applied, but care should be taken that the bleeding does not persist after the removal of the leeches. Blisters also are very efficacious, but render subsequent examination of the heart more difficult. For sleeplessness and precordial distress a dose of Dover's powder may be given.

It is extremely rare for a serous pericardial effusion to be so extensive as to require surgical interference, but if the area of dullness be very great and associated with cyanosis and a very feeble pulse, such may be advisable. The method of procedure is described on p. 213.

Severe cardiac failure may, however, occur apart from a large effusion. The symptoms that indicate this are vomiting, pallor with slight lividity, or cyanosis and restlessness.

The food should consist of milk only, and, if the vomiting persists despite this, rectal feeding must be resorted to. Digitalis is rarely of use, but hypodermic injections of strychnine should be given. If there is much restlessness morphia may be combined with the strychnine. The patient should not be allowed to make the slightest muscular effort. Oxygen inhalations may be given.

After the subsidence of an attack of pericarditis a prolonged convalescence should be insisted upon. It should never be forgotten that the cardiac muscle has been involved, and plays a much more important part in the progress of the disease than the pericarditis; endocarditis is also of common occurrence. The patient should be kept in bed until the pulse-rate reaches the normal, and this may take many weeks.

Muscular exercise should be begun very gently, and after a severe attack should be preceded by a course of massage.

### 3. PYO-PERICARDIUM

This is a somewhat rare affection, and is apt to be discovered unexpectedly at a post-mortem examination. It is met with in pyæmia, and is an occasional complication of empyema and also of chronic renal disease.

The most important cause, perhaps, is empyema, for the reason that the pericardial complication is very apt to be overlooked, and if untreated is fatal.

The onset of pyo-pericardium is commonly very insidious. In the presence of the signs of empyema, particularly when on the left side, the increased area of cardiac dullness may be overlooked. Even after drainage of the empyema the pericardial complication may not be recognized. The large area of dullness is observed, but is attributed to displacement of the heart and collapse of the lung. Perhaps the most valuable indication is the evidence of circulatory failure; the face becomes pale, with lividity and even cyanosis, the pulse extremely feeble, and the patient restless. When these symptoms develop in a patient

after adequate relief of an empyema, the presence of pus in the pericardium should always be suspected and a thorough re-examination made. The presence of a large area of cardiac dullness, often extending well into the lower left axilla, and of muffled, indistinct cardiac sounds, would confirm the suspicion.

The treatment is described on p. 213.

#### 4. CARDIAC FAILURE

The importance of careful observation of cases presenting early symptoms of cardiac failure cannot be overestimated, as the prompt adoption of precautions, above all of rest, will often ward off a serious attack. The condition of the cardiac muscle is the dominating factor in heart affections. If the main incidence of cardiac rheumatism has fallen on the valves it is astonishing with what efficiency a healthy cardiac muscle will overcome mechanical valvular defects. If the heart muscle has suffered severely, response to treatment may be very limited. In older people with degeneration of cardiac muscle, the result of prolonged working against a high blood-pressure coupled with diminishing blood-supply to the heart-wall from progressive changes in the coronary arteries, cardiac symptoms are common and severe; but even in such cases rest and attention to diet will often give years of fair comfort in cases apparently hopeless.

All cases presenting the slightest signs of genuine circulatory embarrassment after slight exertion, the early symptoms of the so-called 'broken compensation', should therefore be regarded as cases of urgency and thoroughly investigated. By careful adjustment of the mode of life the work demanded of the heart will often be well within its range, and further, the cardiac reserve will frequently steadily increase.

Acute cardiac failure may, then, under favourable circumstances, often be indefinitely postponed; but with damaged heart muscle, or with severe valvular defects and under unfavourable circumstances, various urgent symptoms present themselves.

##### *A. Cardiac Failure in Chronic Rheumatic Endocarditis*

(i) *Mitral incompetence.* The commonest condition is mitral incompetence with dilated left ventricle and auricle, pulmonary congestion, and dilatation of the right side of the heart. Edema is almost invariable, the veins of the neck are dilated and pulsatile, cough is common, the urine is scanty, albuminuria is present, and the liver is enlarged.

*Treatment.* The severity of the attack determines the activity of treatment. Complete rest in bed is essential. If the right side of the heart is much dilated, as evidenced by dullness on percussion to the right of the sternum, with distended and pulsating cervical veins, cyanosis, and a feeble pulse, venesection may be performed (see p. 209).

It is important that the blood should flow rapidly, as the distension of the right auricle and ventricle is thereby quickly relieved. From ten to twenty ounces of blood should be removed, and the relief is often immediate and striking. Leeches are sometimes useful (see Mitral Stenosis).

Digitalis should be given at once; its effect in these cases is extremely good, but it must be given in sufficiently large doses. For an adult, 15 minims of the tincture should be given every four hours or even every three hours. The effect is often not perceptible for a couple of days, when the pulse-rate will be found to be falling and the urinary secretion increasing. Marked diuresis is often associated with rapid disappearance of œdema. The drug can then be diminished. The failure of digitalis is often due to its being given in insufficient quantity. If digitalis causes vomiting the dose should be diminished, or strophanthus in 10-minim doses substituted, but the latter is not so efficacious. In bad cases strychnine may be combined with digitalis or given hypodermically, gr.  $\frac{3}{16}$  every six hours, but is of very small value compared with digitalis. If there is much œdema of lungs and bronchitis, ammonia and ether should be given. Oxygen inhalations are also useful, and three leeches may be applied to the base of each lung.

*Dropsy.* Œdema of legs, even when extreme, will often rapidly disappear with the above treatment; sometimes, however, it fails to diminish, and other measures have to be taken. In the first place the fluid intake should be lessened; at the most three pints of fluid daily should be allowed, but less is desirable. The bowels should be well opened. Half an ounce of sulphate of magnesia or of soda may be given before breakfast. The compound digitalis pill (one grain each of powdered digitalis leaves, powdered squill, and mercurial pill) once or twice daily sometimes acts very well. Caffein citrate (gr. v) or diuretin (gr. xv) may be added to the digitalis mixture. Theocin sodium acetate (gr. v) three times daily is sometimes extraordinarily successful in producing a copious diuresis with rapid diminution of dropsy, unfortunately it seldom succeeds a second time with the same patient; but if œdema is extreme, it should be given with digitalis.

The legs may be punctured and the fluid allowed to drain away, but most careful precautions should be taken and the legs wrapped up in antiseptic gauze or cotton-wool.

The chest should be examined for pleural effusion, and even if there are signs of only a moderate collection aspiration should be performed if there is much dyspnoea. Similarly, ascites may require relief by paracentesis abdominis.

*Insomnia* is most distressing, and has a most harmful effect. It may yield to chloralamide, chloral, or bromide. If these fail, a hypodermic injection of  $\frac{1}{6}$  or  $\frac{1}{4}$  grain of morphia should be given; the relief both of dyspnoea and insomnia is often very striking. Hot brandy or whisky and water at night is a useful sedative.

(ii) *Mitral stenosis*. In mitral stenosis a different picture is often presented. Œdema may either be absent or only slight. The acute symptoms are rather those of acute bronchitis or œdema of lungs, with hæmoptysis, and a feeble irregular pulse. Cyanosis is nearly always present. The diagnosis is often overlooked for several days, as the mitral presystolic murmur disappears with great dilatation of the left auricle, and the cardiac sounds are difficult to hear in the presence of the numerous rhonchi and râles. A rather loud first sound is frequently present, and is very suggestive of mitral stenosis.

*Treatment*. Absolute confinement to bed is of course essential. Venesection is most useful. The indications for its employment are a distended right ventricle, often with marked epigastric pulsation, a small feeble pulse, distended and pulsating cervical veins, dyspnoea, and cyanosis.

If the symptoms are not quite so severe, six or more leeches may be applied over the liver. They should be applied over the lower ribs, not over the abdominal wall below the costal margin, so that if troublesome bleeding follows compression can be applied more easily. It is not uncommon for a suture to have to be used to arrest bleeding from leech-bites below the costal margin. The acutely distended liver is often very painful, and leeching gives very great relief.

Oxygen inhalations should be used if the dyspnoea and cyanosis are marked; the pulmonary system is engorged and œdematous, and the surface available for aëration greatly diminished. A bronchitis-kettle is also of great use. Leeches may also be applied with advantage over the base of each lung.

Stimulants, such as ammonia and ether, are advisable. Digitalis should always be given, and its results are, on the whole,

better in proportion as mitral incompetence and dilatation of the left ventricle accompany the stenosis ; but even in pure stenosis it should be given. The effect of the drug is not limited to the left ventricle, though the right ventricle does not respond so well. It need not be used in such large doses, nor so frequently as in mitral incompetence. Calomel, gr. v, or blue pill, gr. v, followed by a saline purge, should be given.

When oedema is a prominent feature it should be treated as described under mitral incompetence.

(iii) *Aortic disease.* The most serious attacks of cardiac failure in aortic disease occur in cases in which the mitral valve is also incompetent. This may be due to secondary dilatation of the left ventricle, or to the endocarditis having also injured the mitral valve. When the mitral incompetence is of a high grade the case must be treated as already described under that heading. Severe symptoms, however, occur in cases in which the mitral valve is not involved, or is only slightly affected. Sudden death is not uncommon. The urgent symptoms that may arise are severe syncopal attacks, dyspnoea, sleeplessness, and cardiac pain. Definite anginal pain frequently occurs. Mental symptoms are not infrequent, and acute mania may occur.

*Treatment.* The patient must be kept in bed, and, in view of the tendency to fatal syncope, the recumbent posture should be maintained until very definite improvement has taken place. Stimulants, such as strychnine, ammonia, and ether, should be given. It is commonly held that digitalis is dangerous, and that it may be responsible for sudden death in aortic incompetence ; but inasmuch as sudden death is not uncommon in the disease, it is difficult to determine the influence exerted by digitalis in this direction. It is certainly not so valuable in this condition as in mitral disease ; it should be used with caution, given in smaller doses, and stopped at once if the pulse becomes slower than normal or if vomiting occurs.

The anginal pain often responds promptly to nitro-glycerine, and much benefit may result from gr.  $\frac{1}{100}$  three times daily.

For the restlessness, distress, dyspnoea, and insomnia, hypodermic injections of morphia are invaluable.

In adults the possibility of the syphilitic origin of aortic disease should always be borne in mind. Syphilis not infrequently affects the aortic valves and the aortic wall immediately above the valves, and mercury and iodide of potassium are occasionally very beneficial.

### B. *Cardiac Failure in Cardio-sclerosis*

Changes in the cardio-vascular system are very common in elderly people. The chief factors producing these changes are prolonged muscular strain, alcoholism, over-eating, syphilis, lead-poisoning, gout, and chronic renal disease.

A high blood-pressure is a common accompaniment, and the heart is usually hypertrophied in response to the increased work thrown on it by the arterial changes. At the same time the cardiac muscle tends to become degenerated, the result, in great measure, of diminished blood-supply; this may be due to atheroma of the coronary arteries, or of the root of the aorta involving the orifices of the coronary vessels.

In many cases the aortic valves are sclerosed, with resulting aortic incompetence. If the heart becomes much dilated mitral incompetence follows, with its resultant train of symptoms. Mitral incompetence is common apart from aortic disease.

The degree to which the cardiac muscle is affected is of much greater importance than any valvular defect; thus the marked cardiac irregularity which is so frequently present depends on myocardial changes. The pulse may show different varieties of irregularity; the rate may be much increased, and this may be paroxysmal (paroxysmal tachycardia). With degeneration of the auriculo-ventricular bundle the symptoms of heart-block may appear, the transient ventricular arrest giving rise to syncopal or epileptiform attacks (Stokes-Adams syndrome).

Finally, in many of these cases the clinical symptoms are the result of more than one pathological condition. Common accompaniments are: generalised arterial disease, chronic renal disease with uræmia, cirrhosis of the liver, bronchitis, and emphysema. It is clear, therefore, that very varying clinical pictures may be presented.

The earlier symptoms are due to diminution of the reserve force of the heart manifested by dyspnoea on slight exertion, cardiac asthma, bronchitis, and so forth. Later the symptoms of any valvular defect make their appearance. Insomnia is often a marked feature, and is sometimes associated with delirium or other mental defects. Angina pectoris is of frequent occurrence.

*Treatment.* Cases with mitral incompetence may be treated on the lines laid down on p. 218. Venesection is often very useful. Digitalis should be tried, though it is not so valuable as in cases of cardiac failure from rheumatic mitral endocarditis in younger people. The compound digitalis pill (one grain each of



powdered digitalis leaves, powdered squill, and mercurial pill), once or twice daily, sometimes acts very well. It should be remembered that digitalis raises the blood-pressure which is often already high in these cases. If so, a vaso-dilator such as nitro-glycerine should be given also, in the form of one minim of liquor trinitrini three or four times daily. Strophanthus is sometimes given in preference to digitalis, as it does not raise the blood-pressure. Nitro-glycerine is very useful in cases with aortic incompetence and anginal pain, but these cases are often most difficult to treat; the peripheral resistance is high, despite the appearance of low blood-pressure which the water-hammer pulse suggests; the heart is nearly always degenerated from coronary disease, and the development of incompetence of the aortic valve is the final blow to its efficiency. The lowering of blood-pressure by nitro-glycerine or erythrol tetranitrate sometimes gives the greatest relief. If, however, no benefit accrues from its use it should not be persisted in.

Restlessness and insomnia often urgently demand attention. Potassium bromide, gr. xx three times daily, does good in some cases, or ten grains of chloral may be given in the evening. Nothing, however, gives such good results as morphia, but it should be given in small doses, at any rate at first. It is of great value also in the paroxysmal attacks of cardiac asthma. In the presence of bronchitis morphia should be withheld, or only given in minute doses. Alcohol at night is sometimes a good sedative. The bowels should be kept well open. Much food should not be forced on a reluctant patient with severe symptoms, and fluids especially should be restricted.

It goes without saying that absolute rest is essential, but the patient should be allowed to sit up in bed. Strychnine hypodermically seems to do good and should be given. In the final stages little can be hoped for but to alleviate distress, but many attacks of severe cardiac failure in these cases are brought on by strain, and are recovered from in the most surprising manner.

## 5. ANGINA PECTORIS

This is most commonly met with associated with one or other of the following conditions: (1) Aortic aneurysm. (2) Aortic valvular disease. (3) Atheroma of the coronary arteries. (4) Myocardial degeneration. (5) Increased arterial pressure of the elderly (usually associated with 3 and 4).

In its complete form the attack is very characteristic, but it often commences with mild attacks, gradually increasing in severity. On the other hand, the first attack may be very severe and fatal.

(a) *Treatment of the attack.* Inhalation of amyl nitrite is the most successful remedy, and in many cases gives almost immediate relief. Nitro-glycerine, gr.  $\frac{1}{100}$ , in chocolate tablets is almost as efficacious. Its action is of necessity a little slower, but many patients prefer it to the amyl nitrite, and, as the attack is frequently of gradual onset, the patient is able to take the tablet at the first warning, in time to prevent the full development of the attack. Similarly the vaso-dilatation induced by hot drinks, such as brandy and water, will often give relief.

In cases in which the pain does not yield to the above treatment a hypodermic injection of morphia should be given, and, if necessary, followed by chloroform inhalation.

When the attack is preceded or accompanied by vasomotor symptoms, especially coldness of the extremities, external warmth should be applied by means of hot-water bottles or hot blankets.

In some cases the attacks become very frequent, so that, although the patient is permanently in bed, they are induced by any exertion such as straining at stool, the effort of taking food, or by the slightest emotion. In this stage, in addition to erythrol tetranitrate or sodium nitrite, the greatest relief may be obtained by opium, a grain or more of which may be given as a pill, night and morning. This not only relieves the pain but materially lessens the mental anxiety. Chloral in 5-grain doses two or three times daily is also sometimes very useful.

(b) *Treatment between the attacks.* Careful treatment will often largely diminish the number of attacks. Every case must be thoroughly investigated, and the mode of life modified so as to relieve the heart of strain. To this end muscular effort should be avoided, as in many patients the attacks are definitely related to muscular exertion. Walking uphill should be forbidden, and walking against a strong wind is especially risky. Cold is harmful, and the patient should be carefully wrapped up. Mental strain should also be avoided, and business responsibilities given up or reduced to a minimum.

The diet should be supervised. Heavy meals and rich foods should be prohibited, as a distended stomach is very prone to precipitate an attack. Very light meals, and, if necessary, an extra meal in the twenty-four hours, agree very well in some

cases. Alcohol should be taken sparingly. The bowels should be kept well open.

A course of iodide of potassium (gr. v to x three times daily) is often very efficacious. When the attacks recur frequently despite all care, erythrol tetranitrate may be tried, commencing with gr.  $\frac{1}{4}$  and increasing to gr.  $\frac{1}{2}$  or gr. j three times daily.

It is important to remember that angina pectoris occurs in very different degrees of severity.

The case should be gone into with the greatest care, and it is often wise to explain the matter at length to the patient. This will commonly ensure his active co-operation, and the diminution in the number and in the severity of the attacks is often surprising. Many patients enjoy good health and comfort for many years by following out a carefully considered programme. This should often include a period of absolute rest, to enable an exhausted heart to recover some of its reserve force.

#### 6. THROMBO-PHLEBITIS

Non-infective thrombo-phlebitis is an occasional complication of certain specific fevers, especially typhoid fever; it is not infrequently met with in chlorosis; after abdominal operations; after severe hæmorrhage, and in the gouty. It is a common complication of varicose veins.

Although much less important than the septic form, it requires notice as an emergency from the point of view of its treatment in the acute stage. In practice treatment is restricted in the main to the treatment of peripheral thrombosis, especially of the legs. Pulmonary embolism from detachment of a portion of the clot is the chief danger to be feared. It is therefore necessary that absolute rest in bed should be enjoined. The leg should be enveloped in cotton-wool and placed upon a pillow. Pain is often severe, and the limb may be shielded from the weight of the bedclothes by a cradle. Applications which require frequent changing should be avoided on account of the disturbance caused by the dressing, but some simple preparation such as belladonna or atropine liniment may safely be employed.

When the saphenous vein is alone involved the patient should be kept in bed for about two weeks after the pain has subsided.

If the common femoral vein is involved complete rest for at least six weeks should be insisted on, and a longer period may be necessary. Gentle massage of the limb may be employed after the acute symptoms have passed off, the vein being avoided.

It is a common practice to add twenty grains of citrate of soda to each glass of milk in order to precipitate the calcium salts, with the hope that the tendency to coagulation of the blood may thereby be lessened.

As a preventive measure rubbing of the limbs in an upward direction, with the view of assisting the venous circulation, has been recommended in the case of patients liable to this complication, such as those laid up with hæmatemesis from gastric ulcer.

An elastic bandage should be worn after getting up, but if the subject be young and a good anastomotic circulation develops this may subsequently be dispensed with.

*Infective thrombo-phlebitis.* See p. 67.

## 7. EMBOLISM

Emboli which lodge in the systemic arteries usually originate in the left side of the heart, but they may also arise from parietal thrombi forming in the main arterial trunks. Embolism is rare in the large systemic arteries, but is common in the cerebral, splenic, and renal arteries. The results vary with the importance, position, and anastomotic possibilities of the vessel involved. If there is a good blood-supply with free anastomosis, as in the case of the liver, no effect may be produced, but in other positions necrosis of tissue takes place; softening occurs in the brain, and solid infarctions in the spleen and kidney. If the artery is one of vital importance, such as the main trunk of the pulmonary artery, or a coronary artery, death may be immediate. In certain positions embolism is followed by hæmorrhage; hæmoptysis occurs in pulmonary infarction, hæmaturia in renal infarction, and bloody stools in embolism of the mesenteric arteries. If the embolus is infective, a metastatic abscess is usually produced.

We shall only consider embolism of the arteries of the limbs, pulmonary embolism, and air embolism. Cerebral embolism is dealt with on p. 363.

### *A. Embolism of the Arteries of the Extremities*

Pain is always present; it is sudden in onset and often very severe. Sensory disturbances are present, either complete anæsthesia of the limb or mere blunting. Muscular weakness follows the loss of the blood-supply and varies from slight weakness to complete paralysis. Pulsation is absent below the site of the embolus, and the limb rapidly becomes pale and cold.

There is little or no cedema as compared with that which accompanies venous thrombosis.

Gangrene usually follows embolism of the femoral or popliteal artery, but much depends upon the age of the patient. In a young and healthy subject with sound vessels, recovery may be rapid with a useful though somewhat crippled limb, but in elderly people with rigid vessels gangrene is almost inevitable.

*Treatment.* Morphia should be given for the pain. The limb should be placed in the horizontal position, warm cotton-wool applied and frequently renewed. Good results have been reported from manipulation of the vessel at the site of embolism if it is accessible; if the obstructing clot is soft it may by this means be broken up, and the resulting smaller fragments will give rise to embolism in the smaller and more distal branches. By this means gangrene may be avoided or limited in extent. Great care must obviously be taken lest the vessel wall be injured, as there is a distinct tendency to the development of an aneurysm at the site of embolism. If gangrene occurs, amputation is inevitable. (See p. 69.)

#### B. *Embolism of the Pulmonary Artery*

Pulmonary embolism may occur as the result of the detachment of a clot in cases of venous thrombosis; but in other cases, and especially after surgical operations, it is produced by the detachment of a clot formed either in the pulmonary artery itself or in the right ventricle. In one condition the clot is attached to the apex of the right ventricle and extends as a long worm-like process through the pulmonary valve. Should the ventricular attachment give way, the long clot curls up and blocks the pulmonary orifice. We have seen sudden death in a patient convalescing from typhoid fever in whom this condition was found at the autopsy.

The symptoms vary with the position in the main trunk or its branches at which the embolus is arrested.

(i) *Of the main artery.* If the clot is large and the lumen is completely blocked, death is instantaneous, but should the disposition of the clot allow some blood to pass by it, the patient may live for a few minutes. The onset of symptoms is sudden; there is a sense of oppression and sometimes of pain in the chest, which may be referred to the lower end of the sternum. The interference with the pulmonary circulation causes intense dyspnoea, and the patient is in extreme distress. The face is pale and cyanosed, and the pulse is almost imperceptible. On auscultation, air is found to enter the lungs freely, and this, com-

bined with the sudden onset of intense dyspnœa, forms a most characteristic sign.

(ii) *Of a medium-sized branch.* The onset is sudden, with pain or sensation of oppression in the chest. The pulse is small and feeble, and the face pale with slight cyanosis. A basal systolic murmur is sometimes audible. A considerable portion of the lung, usually the right lower lobe, becomes infarcted; the percussion note is at first impaired, and gradually becomes dull with feeble breath sounds, crepitations, and sometimes tubular breathing. A friction rub is common, for the infarcted portion of lung usually extends to the pleural surface. Hæmoptysis is usual, and the blood is bright red, at any rate at first. This and the irregular fever helps to distinguish this condition from pneumonia; many cases of so-called post-operative pneumonia are really the results of pulmonary embolism.

(iii) *Of small branches.* There is usually pain, cough, and blood-streaked sputum. The physical signs may be very scanty, and may merely amount to a few crepitations or slight pleural friction.

*Treatment.* When a big branch of the pulmonary artery is blocked, and death is not immediate, hypodermic injections of ether should be given; ammonia and ether by the mouth; and oxygen inhalations. Morphia should be given in full doses to relieve the dyspnœa and distress.

When the symptoms are not so urgent the patient should be kept absolutely at rest for fear of further detachment of clot. Morphia and stimulants should be given if necessary.

The milder cases require no special treatment.

### C. Air Embolism

This rare accident may occur in cases of cut throat or during operations upon the neck and axilla, and is due to an inspiratory effort made at a moment when the wounded vein is, for some reason or other, held open and unable to collapse. Erichsen quotes an instance in which air entered a wounded facial vein during an operation upon the parotid gland, and another in which a wounded subscapular vein provided the point of entry.

*Symptoms.* These vary both with the rapidity with which the air gains entrance, and also with the amount introduced. At the moment of the accident a peculiar hissing noise is heard, and bubbles of air are seen in the wound. The patient becomes suddenly pale, the pulse accelerates, and the pupils dilate. On listening over the heart, a churning noise is said to be audible, and a thrill may be felt. If much air enters the vein, death

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speedily results, but with smaller quantities recovery takes place after a variable period of anxiety.

*Treatment.* The first care is to prevent any further entrance of air by placing the finger immediately upon the wounded vein, and then securing it with a rope and ligature. It has been recommended that the wound should be flooded with water whilst the wound in the vein is being sought for and secured. The next point is to keep the patient alive whilst the air that has entered is being got rid of. The chief reliance is to be placed upon artificial respiration, which assists the frothy blood through the lungs, and relieves the congestion of the right side of the heart. At the same time, if any signs of cardiac failure appear, stimulants should be administered.

## CHAPTER XIII

### ACUTE ABDOMINAL DISEASE

*Definition.* By an acute abdominal disease is meant an acute illness of mechanical, infective, or vascular origin, occurring in connexion with the alimentary canal, the peritoneum, or the abdominal and pelvic viscera, and associated with urgent symptoms, among which abdominal pain, vomiting, constipation, and shock predominate.

It is only in the earlier stages that an exact diagnosis is likely to be made by physical examination. In these stages the history is of importance as an aid to the interpretation of the physical signs, but the longer the interval between the onset and the examination the more will reliance have to be placed upon the history. The reason is not far to seek. Whether the initial lesion is a perforation, an obstruction, or the torsion of an ovarian pedicle, the fatal issue, if the case is untreated, will be due to the same cause, namely peritonitis. The subject of intestinal obstruction does not die because the flow of the intestinal contents is arrested, but because the vitality of the intestinal wall is so interfered with as to permit of the passage of bacteria into the peritoneal cavity. There are, it is true, cases in which death is due to causes other than peritonitis. For example, the perforation of a gastric ulcer has been known to cause death almost suddenly from shock; and a ruptured tubal pregnancy may rapidly bring about the fatal issue from hæmorrhage alone. But in the great majority of cases the peritoneal infection which will sooner or later result from any acute abdominal lesion is the factor of vital importance. It is, therefore, the prevention and treatment of peritonitis which is the primary object of surgical interference, and the earlier a diagnosis can be made and operation undertaken, the more likelihood will there be of recovery.

#### *Diagnosis*

##### A. PREVIOUS HISTORY

As already mentioned, greater reliance has to be placed upon the history, in proportion as the progress of the case and the onset of peritonitis gradually obscure the earlier physical signs.



the presence of growth, or the apex of an intussusception; tenderness localized to one side of the pelvis may be evident; or an actual inflammatory induration or mass may be felt.

11. *Vaginal examination* may be even more valuable. The condition of the uterus, the ovaries and tubes, and of Douglas's pouch can be ascertained, as also unilateral or bilateral tenderness, and depression of the fornix.

12. *Examination of the urine.* The presence of albumen, of blood, or of pus may determine the renal or vesical origin of acute abdominal symptoms; bile would indicate biliary obstruction; and sugar would suggest the possibility of disease of the pancreas.

### C. EXAMINATION OF THE ABDOMEN

It is advisable always to examine the abdomen systematically according to some fixed plan, lest any points of importance should be overlooked.

1. *INSPECTION.* The patient must be placed flat upon the back, with the head low, and the whole abdomen exposed in a good light. Attention is to be directed to:

(a) *Abdominal respiratory movements.* With free movement there is not much likelihood of serious mischief, *unless the patient is under the influence of opium.* If the movement is impaired, it must be noted whether the impairment is general or local; thus the left upper quadrant may move little or not at all in a case of perforated gastric ulcer, while the right upper quadrant shows quite a fair range. Similarly in cholecystitis the right upper zone is affected.

(b) *Distension.* Distension may be general, or it may be local. Local distension is of the greatest importance, and may give a clue to the diagnosis. It is very commonly present, for instance, in appendicitis. In looking for this sign, the abdomen must be inspected not merely from the side of the bed, but the examiner must lean over the patient so that he can see it from above. The patient must, for this purpose, lie absolutely flat, with the legs straight and symmetrically placed. With such precautions, a slight fullness in the right iliac fossa in appendicitis, or in the right loin from a high appendix abscess, or a bulging in the region of the lower ribs from a subphrenic abscess, may be readily detected.

The lower half of the abdomen is the first to show distension in pelvic disease; the upper in pancreatic, gastric, duodenal, and gall-bladder affections. With great abdominal distension from

dilated coils of intestine, or from the presence of much fluid, or from both causes combined, the local signs which were probably present in earlier stages disappear, and the skin assumes a shiny, glossy appearance.

(c) *Peristaltic movements*. These are not usually seen in acute obstruction, but are very common in chronic and incomplete obstruction, and the belly-wall may rise and fall as the result in a most characteristic fashion, the contour of the contracting coil being clearly visible. The movements are best seen in thin patients, and are often a sign of considerable hypertrophy of the muscular wall of the bowel; when well marked they are highly suggestive of a pre-existent chronic obstruction.

2. **PALPATION**. After thorough inspection, the abdomen should be palpated. The hand should be warm and laid flat upon the abdomen. As a rule, only the slightest pressure should be used, and deep pressure, if used at all, should be reserved until after a thorough examination by the flat hand laid lightly on the abdominal wall. To dip the fingers deeply into the abdomen is not only very painful, but evokes such reflex rigidity as to interfere seriously with further examination. The normal abdomen presents to the palpating hand an elastic and yet at the same time a somewhat doughy feeling.

Bimanual palpation must also be employed, one hand being in the loin behind, the other in front. It is of particular value in renal tumours.

The points to be sought for are :—

(a) *Pain and tenderness*. This may be local or general. In peritonitis the abdomen is often extremely sensitive to pressure; in obstruction, on the other hand, palpation is rarely resented; whilst in intestinal colic firm pressure may actually relieve the pain.

The exact *locality of the pain* is important. At the onset it is often general or is referred to the umbilical region, but a little later the situation of the pain as referred to the abdominal wall is a fair indication of the position within the abdominal cavity of the seat of mischief; with the generalization of peritonitis the pain again becomes general. As examples, one may note the pain in the left upper quadrant of the abdomen in perforation of a gastric ulcer, the pain over the gall-bladder region in cholecystitis, in the epigastrium in pancreatitis, and in the right iliac fossa in appendicitis. In perforation of a typhoid ulcer the pain is often situated at a point upon the abdominal wall exactly overlying the site of perforation.

The *character of the pain* should also be noted. In perforative

lesions it is often very severe, and may be agonizing. In acute obstruction the pain is also extremely severe, but in the less urgent forms of obstruction it may be of a colicky, paroxysmal character resembling that of lead colic. In peritonitis the pain is more persistent.

(b) *Rigidity*. This also may be local or general. With a local lesion, such as cholecystitis, only a single segment of the rectus abdominis muscle may be rigid. Care must be taken to avoid mistaking the rounded outline of one of these contracted segments for a tumour underlying the abdominal wall. The lower edge of the upper segment has often been mistaken for the edge of the liver, but it does not move with respiration.

(c) *The presence of a tumour or inflammatory mass*. The whole abdomen is to be carefully examined from this point of view. If any abnormal mass is detected its special features are to be noted, whether it is hard, soft, tender, or tense; the last feature would suggest a cyst or localized collection of fluid. Most important of all is the position of such mass. Its position may correspond with that of the gall-bladder, the appendix, or the kidney; it may rise out of the pelvis and suggest a distended bladder, or disease of the ovary, Fallopian tube, or uterus; it may be superficial, as in the case of splenic enlargement, or deep, as in a renal tumour. The effect of respiratory movements on the mass is to be noted.

(d) *The presence of free fluid*. If present in large amount, a thrill may be obtained from side to side. If the fluid is only present in the lower half of the abdomen, a thrill is often found from iliac fossa to iliac fossa, and even over a still more localized area. When present in small quantities, its presence must be sought by percussion.

(e) *Gurgling*. A characteristic sign in an incomplete obstruction is the peculiar feeling communicated to the palpating hand when placed over the site of the narrowed portion of bowel. It is produced by the passage of gas and fluid through the narrowed portion.

3. PERCUSSION. In peritonitis percussion causes much pain, and should be practised very gently; in obstruction it causes little or none.

(a) *Undue resonance and extent of resonance*. A conception of the percussion note over the normal stomach and colon, and the normal range of variation over the whole abdomen, is necessary. With great distension of the intestinal coils the whole abdomen may be unduly resonant. A resonant note may be present over a renal tumour, the colon being an anterior relation of the kidney.

(b) *Dullness* may be present in various situations, as over an inflammatory mass or an ovarian cyst.

(c) *Free fluid* is often readily detected by the variation in the percussion note in the flank when the position of the patient is altered. But a shifting note may be found in cases of large distension of the colon, and a bunch of collapsed coils of small intestine sometimes gives rise to the same phenomenon.

(d) *The presence of free gas* in the peritoneal cavity. When a gas-containing viscus is perforated, gas escapes into the peritoneal cavity, and is apt to find its way between the diaphragm and the upper surface of the liver, causing the appearance of a band of resonance, of varying extent above the right costal margin. Much controversy has raged round this sign, but used properly it is most valuable. Prof. Osler, in a paper on perforation in typhoid fever, pointed out the value of this obliteration of the liver dullness *when occurring in a flat or not greatly distended abdomen*. With great distension of the intestinal coils the liver is pushed upwards and possibly rotated backwards on its transverse axis, with the result that the normal area of liver dullness is diminished or absent. With these precautions in mind, the sign is a most valuable one. Shifting resonance from the presence of gas is also met with in the lower thoracic region in the purely localized collections of pus and gas found in perforations of gastric or duodenal ulcers in the subphrenic regions. In these latter conditions a 'bell sound' may also be met with.

#### D. EXAMINATION OF THORAX

This must always be carried out, for its neglect has led to serious errors of diagnosis and treatment. The condition of the lungs and of the pleural sacs is of special importance.

Acute pulmonary or pleural disease, such as lobar pneumonia, broncho-pneumonia, pleurisy and empyema, not infrequently give rise to urgent abdominal symptoms, due to pain referred to the abdominal distribution of the lower dorsal nerves. Acute pain and tenderness may be present in the epigastric and hypogastric regions, and this, together with rapid shallow breathing and rapid pulse, may so simulate an acute abdominal affection as to be the cause of an unnecessary laparotomy being performed. The undue rapidity of the breathing, and the fact that the signs are usually in the upper part of the abdomen, should compel a most careful examination of the thorax, which will usually reveal the presence of some such disease as above mentioned. It must,

however, be borne in mind that with great abdominal distension the bases of the lungs are partially collapsed, with impairment of resonance and of air-entry.

The heart also should be carefully examined, though it is very rare for cardiac or pericardial affections to simulate abdominal disease.

#### *E. CONDITIONS PRESENTING ACUTE ABDOMINAL SYMPTOMS WHICH MAY GIVE RISE TO ERRORS OF DIAGNOSIS AND TREATMENT*

Other conditions besides intrathoracic disease give rise to symptoms which may lead to an unnecessary abdominal exploration. These are :—

1. Lead colic, p. 280.
2. Biliary colic, p. 281.
3. Renal colic, p. 326.
4. The gastric crises of tabes, p. 378.
5. Enterospasm, p. 278.
6. Acute diarrhoea and vomiting in infants, p. 272.
7. Acute dilatation of the stomach, p. 275.
8. Acute abdominal attacks associated with purpura, urticaria, and anægio-neurotic œdema, p. 276.

The possibility of the presence of any of these conditions must never be lost sight of when investigating a case presenting acute abdominal symptoms.

#### MANAGEMENT OF A DOUBTFUL CASE

Even when all the foregoing considerations have been taken into account, it will occasionally be found that exactitude of diagnosis is impossible, and yet that the indications for immediate operation are not definite. Much additional information can then be obtained by attention to the following points :—

(a) *The previous administration of opium.* Owing to the great relief afforded by opium, not only are the typical physical signs obscured, but the patient's general appearance may in no measure correspond to the severity of his illness.

(b) *Necessity for repeated examination.* Re-examination at short intervals, and the noting of any alteration in the condition, especially as regards facial appearance, pulse-rate, temperature, and the abdominal signs, will often afford more information than can be gained at a single examination. It is most important not to administer opium in this stage of uncertainty ; relief may be given by hot fomentations.

(c) *The effects of administering an enema*, and of passing a catheter, are to be noted.

*Note.* In a suspected case of peritonitis, the patient should, as far as possible, be propped up almost into a sitting posture, and this position should be maintained during any transit from room to room or from home to hospital.

#### TREATMENT OF ACUTE ABDOMINAL DISEASE

All the cases of acute abdominal disease which require immediate operation fall under one of the following headings :—

(i) Those in which an exact diagnosis can be made with reasonable certainty.

(ii) Those in which a definite diagnosis cannot be made, yet in which it is obvious that some urgent condition is present calling for immediate surgical treatment.

It is, however, convenient to consider these two groups together, under 'conditions which call for immediate operation', because otherwise much overlapping would occur, as the same lesion will at one time give unequivocal indications of its nature, and at another be quite impossible of exact diagnosis.

The only difference from the operative point of view is that in the first group the incision may be planned so as to provide the most convenient access to the lesion, for example, incision through the upper part of the left rectus for gastric perforation; whilst in the second the incision must necessarily be an exploratory one. It will be convenient first to describe the operation to be performed in this second group, and then to proceed with the systematic consideration of the surgical treatment of these cases of acute abdominal disease.

Unquestionably, the best opening for an exploratory cœliotomy is the one through the right rectus described below. This opening can be so enlarged as to allow of easy access to any part of the abdominal cavity, and there is scarcely any intra-abdominal operation which cannot be carried out through it. Moreover, it has the advantage of providing immediate access to the vermiform appendix, in which the majority of all cases of acute intra-abdominal disease originate.

#### *Exploratory Cœliotomy*

An incision, slightly oblique downwards and inwards, is made over the middle of the right rectus, its upper extremity being just below the umbilicus, and five inches in length. The anterior

wall of the sheath having been incised, the fibres of the muscle are to be separated by means of retractors (Fig. 56), and the posterior wall of the sheath, together with the peritoneum, opened. If the deep epigastric vessels are encountered they may be tied and divided between ligatures. The appendix and pelvic organs can be dealt with through this opening. If the



FIG. 56. Incision for exploratory coeliotomy.

duodenum or gall-bladder is to be examined, the incision must be extended upwards, and it may be carried right up to the costal margin without harm. If the stomach has to be dealt with, the same incision, prolonged, will serve, but it is a better plan to make a second incision through the left rectus above the umbilicus. The incision should never be made either in the mid-line or the semilunar line.

## CONDITIONS WHICH CALL FOR IMMEDIATE OPERATION

These may be placed under five headings :—

1. Hæmorrhage.
2. Intestinal obstruction.
3. Gastric and intestinal perforation.
4. Acute appendicitis.
5. Peritonitis from other causes.

## 1. HÆMORRHAGE

Intraperitoneal hæmorrhage resulting from traumatism is considered in Chapter XV. That which results from disease, such as rupture of an aneurysm or ulceration into a large vessel, rarely if ever comes within the possibility of surgical treatment.

*Tubal pregnancy.* The hæmorrhage from this cause may be of any degree, from a leakage so slow that a localized hæmatocele results without any alarming symptoms, up to an outpouring of blood so rapid as to cause death in a very short time. It is only the more severe cases with which we are here concerned. The signs and symptoms usually leave no room for doubt as to the diagnosis. A woman, who may have missed a menstrual period, is suddenly seized with severe abdominal pain, vomiting, and collapse. The patient is blanched; the pulse is rapid and accelerating; there is pain in the lower part of the abdomen, with tenderness and rigidity: shifting dullness may be found in the flanks, and vaginal examination may reveal the presence of an enlarged uterus, from the interior of which a little dark blood is escaping. When symptoms pointing to this accident are present, even if they are only of slight degree, operation should be proceeded with at once, because, if neglected, the patient is exposed to the risk of death from hæmorrhage, as well as to the dangers of peritonitis.

*Operation.* The abdomen should be opened by separating the fibres of the rectus muscle below the umbilicus on one side or other of the mid-line. The intestines must be displaced upwards and packed off with gauze. The best method of doing this is to use long rolls of dry gauze, of fourfold thickness and about five inches wide. The end of each roll must be left outside the abdomen, and must be anchored by means of a pair of artery forceps. If this is done there need be no anxiety about the possibility of leaving anything behind when the abdomen is closed. The ruptured Fallopian tube is then brought up out of the pelvis,



ligatured with strong silk, and removed. All blood and clot are rapidly removed, either by means of dry sponges or by irrigation with normal saline solution, and the abdomen closed. There is no necessity for drainage. Intravenous saline infusion may be required during the operation, but the patient should never be kept in the theatre for this purpose after the operation is completed. It is better to get her back to bed, to apply hot bottles, and to keep the foot of the bed raised. This position, in addition to combating faintness from loss of blood, also allows fluid to be administered readily *per rectum*. There is almost always a rise of temperature for a few days after operation, but this need occasion no anxiety.

## 2. INTESTINAL OBSTRUCTION

Apart from strangulated hernia, the only forms of intestinal obstruction which can be recognized with certainty before operation are those due to rectal obstruction and to intussusception. It is true that such conditions as acute obstruction due to cancerous stricture of the intestine, obstruction by adhesions in a patient who has previously been the subject of peritonitis or an abdominal operation, and occasionally volvulus, can be recognized with tolerable accuracy, but it is more convenient to consider such cases under the heading of obstruction of uncertain origin.

### A. Rectal Obstruction

(i) *Stricture*. If carcinoma or other rectal stricture is found to be the cause of the obstruction, colostomy should be proceeded with at once. It is well before opening the abdomen, and when the patient is under the anæsthetic, to make a thorough examination of the growth, with a view to determining whether it is capable of removal at a subsequent operation, as this will have a bearing upon the site of the colostomy opening. If it is inoperable, the opening should be made in the pelvic colon as being the most convenient position for an artificial anus; if a subsequent operation is contemplated the transverse colon should be opened, to prevent the difficulties that might arise later from anchoring the intestine too near the site of excision.

*Colostomy*. If the pelvic colon is to be opened, the incision is made one-third of the way along a line drawn from the left anterior superior iliac spine to the umbilicus, at right angles to that line, bisected by it, and three inches in length. The skin, fasciæ, and external oblique aponeurosis are divided in the same

direction, and well retracted. The internal oblique and transversalis muscles are now split in the direction of their fibres, which in this position is nearly at right angles to the first incision, and the wound held widely open with retractors. The transversalis fascia and peritoneum are next divided, and the abdomen thus opened. The distended colon is brought up to the surface, packed round with gauze strips to isolate it from the peritoneal cavity, and clamped on either side of the proposed opening. An incision is next made into the bowel, sufficiently large to admit the introduction of a large Paul's tube (Fig. 57), and a purse-string suture passed round its edge (Fig. 58). When the tube has been inserted, this suture is tied beyond the groove. A strong silk ligature is then tied tightly into the groove upon the tube

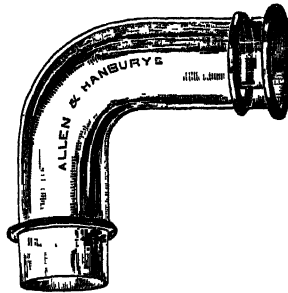


FIG. 57. Paul's tube.

provided for the purpose (Fig. 59). The bowel is now sutured to the parietal peritoneum and the rest of the abdominal incision closed. Some surgeons prefer to suture the colon to the parietal peritoneum before opening it, so as to shut off the peritoneal cavity and prevent faecal soiling.

A similar method may be used for the transverse colon, the abdomen in that case being opened by splitting the rectus muscle just above the level of the umbilicus on either side.

If the colostomy is to be permanent, a simpler method may be adopted. The loop of colon having been drawn out of the wound, a glass rod is passed beneath it, through its mesentery, and resting at either end upon the surface of the abdomen; a piece of rubber tubing serves to keep the rod from slipping out (Fig. 60). Then, if the symptoms are urgent, a Paul's tube may be tied in as described above; but if the symptoms are not so acute, the bowel may be opened a few days later by dividing it transversely upon the glass rod.

(ii) *Imperforate anus*. Any one of several varieties of this

condition may have to be dealt with. If there is an anal dimple, and the full bowel above bulges well into the perineum, it is probable that there will be little difficulty in relieving the obstruc-

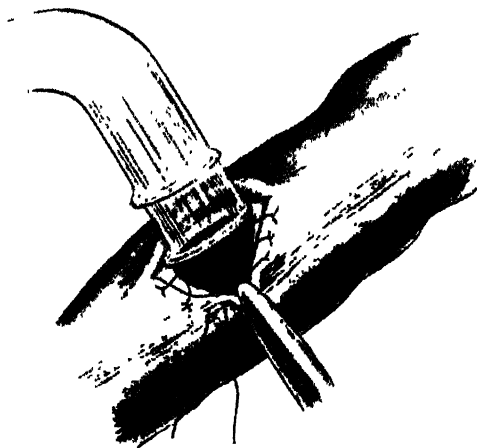


FIG. 58 Introduction of a Paul's tube (semi-diagrammatic).

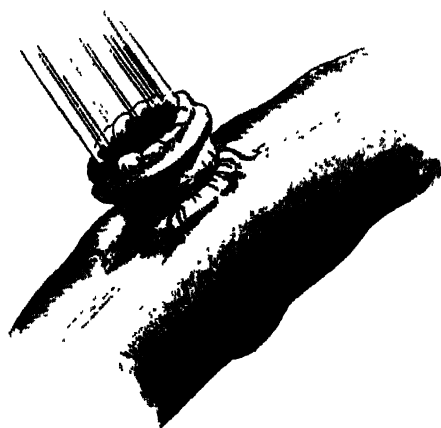


FIG. 59. Paul's tube tied laterally into the bowel (semi-diagrammatic).

tion, but too much reliance is not to be placed upon this sign, because well-marked bulging is sometimes present when the blind end of the bowel is a long way from the surface. The method of procedure should be as follows :—

The child lies upon the back, with the thighs flexed and

abducted, and the buttocks over the end of the table. If an anus is present it should be explored with a probe, and if a mere septum is discovered it should be incised and the finger passed into the bowel to dilate the opening.

If the blind end is not so easily reached, an incision is to be made into the perineum and gradually deepened until the bowel is found. This should then be seized with forceps, brought down, and sutured to the edges of the perineal incision. When all is secure it should be opened, and the orifice dilated.



FIG. 60. Colostomy: first stage.

If the blind end is too high up to be reached easily, as, for instance, at the pelvic brim, the operation of *perineal colostomy* may be done. For this purpose the abdomen is opened by a small incision through the lower end of the left rectus muscle, the pelvic colon found, and a piece of fine rubber tubing passed round it, traversing its mesentery. The ends of this tubing are then to be brought out through the perineal wound by an opening made through the post-vesical cul-de-sac, and by this means the loop of pelvic colon is brought out at the site of the anus. The abdominal wound is next closed, and the colon stitched to the edges of the perineal wound and opened. This offers rather a better prospect of success than a simple iliac colostomy.

The more simple cases are frequently successful, but the results

of the more severe operations are disappointing. The child rarely survives long, and if it does it is unlikely that any sphincter control will be established.

### B. *Intussusception*

This form of obstruction is almost confined to infancy. It does sometimes occur in older children, and even in adults, but the great majority of the patients are under twelve months of age. Of 137 cases treated at St. Thomas's Hospital between the years 1875 and 1901, over 90 per cent were under a year old.

*Diagnosis.* The onset is usually sudden, accompanied by abdominal pain, vomiting, and the passage of bloody mucus from the bowel. This may be so abundant that the mother calls it diarrhoea. On examination, the child is usually placid, but looking pale and sunken about the eyes. The abdomen is generally flaccid, and examination will probably reveal a tumour, which may be large or small. The tumour may only be palpable when the involved intestine is in contraction. If the symptoms point strongly to intussusception, and yet no tumour can be felt, there should be no hesitation in giving chloroform in order to assist the examination. The only cases in which the tumour is likely to escape detection are those where it is small and hidden beneath the liver. If the intussusception is large its apex may be felt on rectal examination.

*Treatment.* A few cases have undoubtedly been successfully treated by the old methods of manipulation and rectal irrigation; but such methods are extremely uncertain, and their employment is likely to add to the shock and to waste valuable time. If, however, the facilities for immediate operation are not at hand, and some time must necessarily elapse before it can be undertaken, there is no harm in trying the effect of gentle irrigation of the bowel. This is done as follows :—

The child lies on the back with the pelvis raised upon a cushion, and a tube, connected with a funnel, is introduced into the rectum. The funnel must not be elevated more than two feet above the patient, lest a dangerous degree of pressure should be produced. Warm water is then allowed to run into the bowel, and it may be found that the tumour gradually becomes reduced in size. This is most likely to happen if the tumour is a large one and the symptoms are not very acute. The greater part of the intussusception may possibly be reduced by this means, but it is very unlikely that the whole will be so reduced. Moreover, the disappearance of the greater part of the tumour may lead to the

erroneous supposition that complete reduction has been effected. This method, therefore, should only be employed when operation is unavoidably delayed, and we do not recommend it as a deliberate preliminary to operation with the view of reducing the size of the tumour.

Infants bear abdominal section very badly, and therefore this is one of the few operations of surgery in which rapidity of manipulation is of real advantage and adds materially to the chances of recovery. The question of anæsthesia is an important one, and that of spinal anæsthesia should be considered in this connexion (see p. 8).

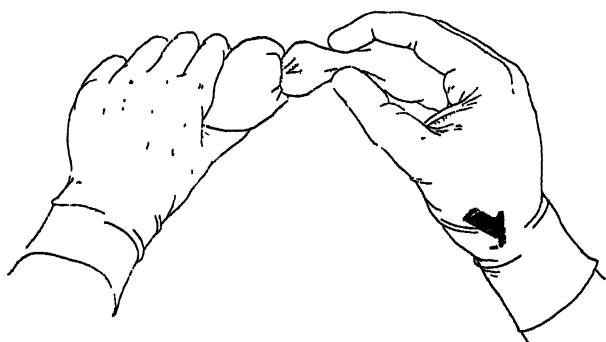


FIG. 61. Method of reducing an intussusception.

*Operation.* An incision large enough to admit two fingers is made through the abdominal wall by separating the fibres of the right rectus muscle below the umbilicus. The tumour is felt, and is then gently manipulated in the direction of the colon towards the cæcum. If the tumour has reached the iliac colon the direction will be first upwards towards the spleen, then across the abdomen towards the hepatic flexure, and lastly downwards along the ascending colon towards the right iliac fossa. As a rule, this part of the operation is accomplished with ease. The cæcum and termination of the ileum should now be brought out of the wound and the remainder of the reduction effected with the aid of vision, otherwise a small portion of the intussusception may remain unreduced. The method of effecting the final reduction is shown in Fig. 61. One hand holds the entering bowel steady, but without undue traction, whilst the other grasps the intestine just beyond the apex of the intussusception, and gently squeezes and pushes the intussusception in the direction of reduction. The abdomen is next closed by means of a few

strong sutures, which include the whole thickness of the abdominal wall. It is doubtful whether the extra time required for suturing in layers is repaid by the results. The sutures should not be removed until the tenth day, as union is occasionally delayed and the wound may burst open if the stitches are removed too soon.

If the intussusception proves to be irreducible either wholly or in part, or is gangrenous, the case assumes a very grave aspect. Recovery after resection of bowel in young children is an event of the rarest occurrence. In the series quoted, the youngest patient to recover after resection was  $8\frac{1}{2}$  years of age. Probably the best chance is afforded by bringing the irreducible portion of the tumour out of the wound, packing it round with gauze and opening it, leaving it to be resected later by an extra-peritoneal operation should the child survive. If the general condition of the patient is fairly good, the tumour may be resected and a Paul's tube tied into each end of the cut bowel, anastomosis being done later. In older children, and in adults, these measures offer a fair prospect of success, but in infants the cases are almost hopeless.

### *C. Intestinal Obstruction of Uncertain Origin*

With the few exceptions already noted it is extremely difficult to diagnose with any degree of precision the cause or situation of an intestinal obstruction. In a large number of cases, therefore, it is necessary to perform an exploratory operation, the surgeon being prepared to deal with any variety of obstruction that may be encountered.

*Operation.* The abdomen should be opened through the right rectus, as described above for exploratory *cœliotomy*. The distended intestine is then to be followed in a downward direction until the site of the obstruction is reached. There are several methods whereby the direction of the small intestine can be ascertained, but the simplest and most generally serviceable is the following: the operator, standing on the patient's right side, takes a coil of intestine in the left hand, and pulls it out of the wound until the mesentery is put on the stretch. The right forefinger is now passed along the lower or left surface of the mesentery until the spine is reached, when it will readily determine by the direction of the root of the mesentery, namely from left to right, the direction of the attached bowel. If the colon is distended there is, of course, no need to trouble about the small gut, as the obstruction must then be in the colon itself below the distended portion.

The site of the obstruction having been reached, any of the following conditions may be discovered. The method of dealing with each will be described under its own heading.

(i) *Carcinoma of the Intestine*

The treatment of this condition may be discussed under two headings :

*Firstly, the growth is not capable of being removed*, or metastases are so evident as to render its removal useless.

The temptation will be to perform a short circuiting operation by means of a lateral anastomosis, but this should in almost every case be avoided. The reasons for this are overwhelming. The distended, inflamed and softened gut holds stitches with difficulty, and healing does not occur readily. Leakage is far more likely to occur from an anastomosis performed upon obstructed than upon normal intestine. Moreover, the bacteria contained in obstructed intestine are of a highly virulent character, and the peritoneum may readily be infected during an anastomotic operation.

The proper mode of procedure, then, in most cases, is to bring out the distended gut immediately above the growth, pack it off from the peritoneal cavity, open it, and tie in a Paul's tube laterally.

This enterostomy opening, which is almost always in the colon or lower ileum, may remain permanently, or, if the condition of the patient warrants it, a short-circuiting operation with closure of the artificial anus, may be performed later, when the intestines have resumed their normal condition.

A word of warning may be given here with regard to multiple growths. Occasionally a case is met with in which the abdomen is full of masses of secondary growth, in which case it may happen that the actual point of obstruction is above the primary tumour, and due to a secondary deposit or to adhesions. In such a case an opening immediately above the growth would fail to relieve the obstruction. The same caution should be borne in mind in dealing with obstruction due to multiple adhesions.

*Secondly, the growth is capable of removal.*

The danger already discussed of anastomotic operations upon obstructed intestine must be borne in mind in deciding how to deal with such a case. The ideal operation of resection and immediate anastomosis, which would be the proper course to pursue in a state of intestinal repose, is not to be thought of during acute obstruction, and the operator should at once make



up his mind that the radical operation cannot be completed at one stage. There are several methods available :

(a) To perform colostomy at some distance above the growth ; to resect and anastomose at a second operation, and to close the artificial anus by a third operation.

(b) To bring the growth outside the abdomen, suture the loop of intestine in this position, and tie a Paul's tube into the gut just above the tumour, leaving the resection to be performed later.

(c) To resect the growth and tie a Paul's tube into each end of the divided intestine, leaving anastomosis and closure of the faecal fistula to be done at a second operation.

In making a selection of one or other of these methods or some modification of them, the chief factor for consideration is the general condition of the patient. If he has already been brought to a state of emaciation and cachexia by septic absorption from an ulcerating growth combined with chronic digestive disturbance, before the onset of the acute obstruction, it is clear that however tempting the local conditions may be, no other operation than that of colostomy ought to be thought of. Another point of importance is the degree of distension and the acuteness of the symptoms. If the bowel is enormously distended, then the less done the better, because the risk of septic infection of the peritoneum is proportionately increased. If, however, the general condition is good, the obstructive symptoms are not very acute, and the bowel is not greatly distended, reddened or œdematous, then the alternatives (b) or (c) may with advantage be adopted. In any case of resection of a growth of the colon, lateral anastomosis is to be preferred, for the dangers of end-to-end suturing of the colon have been abundantly proved.

#### (ii) *Obstruction by Bands, and Internal Herniæ*

These cases are sometimes the most acute, sometimes the mildest forms of intestinal obstruction, the severity of the symptoms depending upon the tightness of the band and the completeness with which the vascularity of the ensnared bowel is interfered with. In this class are also included strangulation of a Meckel's diverticulum; strangulation of a coil of bowel by a Meckel's diverticulum or by an adherent vermiform appendix; and strangulation by the edge of a peritoneal pouch into which a loop of intestine has been herniated.

On discovering that one or other of these conditions is the obstructing agent, the first thing to do is to release the ensnared

bowel, either by manipulation, division of the band, or removal of an appendix or a Meckel's diverticulum, if either of those structures is causing the obstruction. The obstructed bowel is next carefully observed, in order to determine whether it is viable or not. This point is discussed under strangulated hernia (p. 308). If the bowel is viable it should be washed over with saline solution, returned into the abdomen, and the wound closed. If it is obviously gangrenous, or if the probability of its recovery is doubtful, it must be resected.

It has already been stated that intestinal anastomosis is far more likely to fail during acute obstruction than during a period of intestinal repose; but occasionally the risk must be taken. If the gangrenous bowel is low down in the ileum, the best plan is to resect, tie a Paul's tube into each end, and perform anastomosis a week or so later. But if the lesion is high up in the jejunum, the risks of making an artificial anus are as great as those of immediate anastomosis, partly because the patient will rapidly lose ground owing to malnutrition, partly because the skin around the wound is very apt to become digested and to render the subsequent operation both difficult and dangerous. One point of importance must be insisted upon here. If immediate anastomosis is to be undertaken, the length of bowel resected must be much greater than if a two-stage operation is decided upon, in order that the suturing may be done at a considerable distance from the site of strangulation, and therefore through more healthy intestine.

It is not always possible to be certain at what part of the small intestine the gangrenous bowel is situated, but if there is good reason to believe that it is situated fairly low down in the ileum the two-stage operation is to be preferred.

### (iii) *Obstruction by Adhesions*

Many of these cases come under the last heading, but when the adhesion produces a kinking, as opposed to a band strangulation, the pathology of the condition is completely different. In the class of cases just considered, the bowel is not only obstructed, but is in some portion of its length subjected to the risk of gangrene from interference with its vascularity.

In many cases it happens that the gut can be liberated from the structure to which it is adherent, such as another coil of bowel, one of the other viscera, or a mesenteric gland. If such liberation can be effected, any patches denuded of peritoneum should be sequestered by means of Lembert's sutures, in order, if possible,

to prevent the adhesions re-forming. But frequently the extent and density of the adhesions render such a course impracticable. It may, therefore, only be possible to effect a short circuit by a lateral anastomosis between coils of intestine above and below the obstruction. When this is the case the prognosis must be regarded as serious, for the reasons already discussed.

(iv) *Fibrous Stricture of the Intestine*

This is rare, but sometimes occurs as the result of healing of the circular lines of ulceration following strangulation in a hernia.

The strictured coil has been found either free or involved in a mass of adhesions. In the former case the ideal operation would be that of enteroplasty, namely, division of the stricture in the long axis of the bowel, and transverse closure of the resulting wound. When this is not feasible, a lateral anastomosis between the portions of intestine above and below the obstruction should be carried out.

(v) *Obstruction by a Gall-stone*

There are several methods by which a gall-stone may cause obstruction. A large stone may do so by actually blocking the intestinal lumen, but a stone far too small to cause acute symptoms in this manner may do so by producing an acute kink, or even a volvulus. The site of the obstruction is most frequently in some part of the ileum. In dealing with this condition there are two courses open: (a) to open the intestine, remove the stone, and suture the opening, or (b) to manipulate the stone along the small gut into the colon, and leave it to be evacuated thence by natural means. The latter method is to be preferred when practicable, that is to say when the stone is of small size, not firmly fixed, and within a reasonable distance of the ileo-cæcal valve. The objection to the first method is the undoubted risk of incising and suturing damaged intestine, in which the organisms have attained a high degree of virulence. If the stone can be moved easily, it should be pushed along into a more healthy part of the bowel, and thence removed through an incision over it.

(vi) *Volvulus*

Little need be said here about this uncommon form of obstruction. The clinical signs are equivocal, and vary very greatly in severity, according to the tightness of the twist upon the mesentery, and the consequent impairment of nutrition of the bowel which is involved. The treatment will depend upon the extent

to which the vascularity of the twisted loop has been impaired. The signs of necrosis and viability are discussed under strangulated hernia, p. 308.

In some cases immediate resection is the only course open, but if this has to be done enterostomy should be performed, the anastomosis being left until later. But as a rule the portion of bowel which must be resected is so large that these cases are attended by a high rate of mortality. It is therefore wise to observe what changes occur in the vascularity of the imperilled intestine after the volvulus has been untwisted. The appearance may alter so much that a portion of intestine which at first seemed to be quite hopeless may assume an appearance of viability. Any necrotic or doubtful patches should be sequestered individually with Lembert's sutures.

When only a limited area of the intestinal wall is gangrenous, it is best, after releasing the twist, to bring that portion of the bowel out of the wound, and to tie in a Paul's tube at the necrotic spot. By this means drainage is secured, and at the same time the gut is so anchored as to prevent a recurrence of the volvulus. The artificial anus so produced will probably close spontaneously.

### 3. GASTRIC AND INTESTINAL PERFORATIONS

Any ulcer of the stomach or intestine may produce peritonitis by perforation, but the more chronic the disease the less likely is it to give rise to a generalized peritoneal infection, because as the ulcer gradually deepens it tends to become adherent to neighbouring structures. By this means either the base of the ulcer is so strengthened that perforation is avoided, or, if perforation does occur, a localized abscess results.

But another factor often comes into play, namely, traumatism. A sudden strain or distension may at any time rupture the adhesions, and so cause leakage into the general peritoneal cavity. There are therefore two main causes of perforation :—

(i) An active and rapid necrotic process assisted by distension, such as happens in the case of the appendix, or of a typhoid ulcer; and (ii) a tearing through of adhesions at the base of a chronic ulcer, or a rupture of the thinned-out floor of an ulcer.

As the rapidity of the ulceration is largely dependent upon the activity of the organisms at work, so the peritonitis which results from a perforation of the first class is more serious than that which belongs to the second class. In fact the danger of perforative peritonitis has a direct relationship to the nature and

virulence of the organisms concerned in the ulcerative process. In the case of a gastric or duodenal perforation it is rare to find the colon bacillus in the peritoneal exudate, whilst that organism is by far the most frequent one concerned in perforation of the vermiform appendix.

These facts are of importance in their bearing upon the treatment to be adopted in the various cases.

*(a) Perforated Gastric and Duodenal Ulcer*

Under this heading may also be included perforated 'peptic' ulcer of the jejunum, which occasionally occurs as a sequel of gastro-enterostomy.

It is convenient to group these cases together, because the clinical and bacteriological conditions, whilst differing in detail, are similar in their main features. With regard to the bacteriology, the chief point is the rarity with which the colon bacillus is found in the exudate, at any rate in the early stages. Surgical intervention in the early stages offers, therefore, an excellent prospect of recovery.

*Operation.* When the diagnosis can be made with reasonable certainty, the abdomen should be opened through the right or left rectus muscle above the umbilicus. If there is any doubt, the incision should be made below the umbilicus on the right side, because this gives easy access to the appendix and pelvic organs; and should the case prove to be one of gastric or duodenal ulcer after all, it is useful for the purpose of cleansing the peritoneum. In that case it will be necessary to make a second incision at a higher level in order to deal with the perforation.

The greater number of perforations concern the anterior surface of the stomach near the pyloric end of the lesser curvature, or the anterior aspect of the first part of the duodenum. The posterior aspect of the stomach is involved in about one-seventh of the cases. When this is the case the exudation will be found in the lesser sac, and in order to gain access to the perforation it is necessary to tear through the double layer of peritoneum which constitutes the commencement of the great omentum immediately below the greater curvature of the stomach.

When the perforation has been found it should be closed in the following manner: two or three sutures of strong silk are passed, so as to include the greater part of the thickness of the stomach wall, and in such a manner as to invaginate the whole ulcer towards the interior of the stomach (Fig. 62). A second row of Lembert's sutures is then made to cover in the first. Some

surgeons have advocated the performance of a gastro-enterostomy as a routine measure in these cases. The objections to this procedure are, firstly, that it adds an unnecessary risk by prolonging the operation, and, secondly, that in those cases in which such an anastomosis is necessary it can be accomplished with less risk at a second operation.

Having closed the perforation it only remains to deal with the peritoneum. As stated above, the infection is almost always of a mild type, and therefore the interference with peritoneal

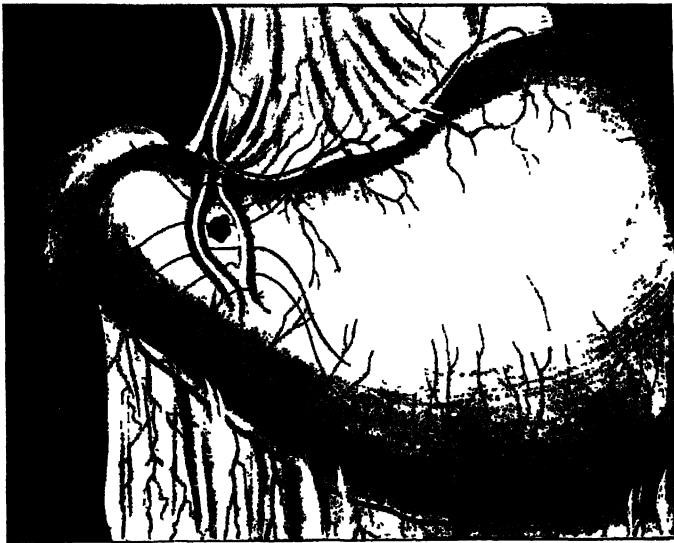


FIG. 62. Method of closing a perforated gastric ulcer (semi-diagrammatic).

phagocytosis, which is occasioned by lavage of the peritoneum, is of little account compared with the desirability of ridding the abdominal cavity of the acid stomach contents and any particles of solid food which may be present. If, therefore, the quantity that has escaped from the stomach is considerable, it is best to wash it thoroughly away with large quantities of saline solution, for which purpose a second incision lower down is of the greatest service. If, however, as often happens, very little has escaped, it is sufficient to cleanse the peritoneum by gentle mopping with dry swabs. The abdomen should be closed without drainage.

The results obtained by these operations have been most gratifying, and doubtless will become increasingly so as the cases

are recognized and subjected to operation more promptly. Thus of 96 cases so treated at St. Thomas's Hospital, up to the year 1907, no fewer than 49 recovered.

(b) *Perforated Typhoid Ulcer*

Cases of successful operation for this otherwise fatal complication of typhoid fever are constantly being recorded, and there are certainly very few instances in which the chance of recovery which surgery offers should not be given. The result of the operation depends so largely upon its being performed as soon as possible that the early diagnosis of perforation becomes a matter of urgent necessity. One sign which helps to distinguish perforation from hæmorrhage in typhoid fever, and is of the greatest value in planning the incision, is the presence of localized

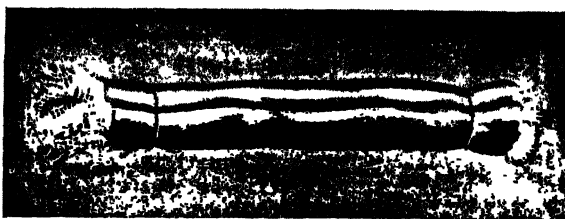


FIG. 63 'Cigarette' drain, consisting of a piece of rubber tissue wrapped lightly round a strip of gauze.

abdominal pain and tenderness. In several recorded cases the patient has been able to point to the exact spot beneath which the perforation has subsequently been found. When a diagnosis of perforation has been made, and the patient's condition is not hopeless, operation should be undertaken without delay. Here rapidity of operation and the avoidance of unnecessary exposure and manipulation are factors of the greatest importance.

*Operation.* The incision, unless there is elsewhere a definite spot of tenderness, should be made through the right rectus muscle below the umbilicus. If the perforation is not immediately evident, the termination of the ileum should be sought for, and the intestine followed upwards. As a rule, the perforation will be found within a few feet of the ileo-cæcal valve. It should be closed by a double row of sutures passed in such a manner that the resulting line of junction lies transversely to the long axis of the bowel. It should be remembered that in several recorded cases a second perforation has been present, and it is therefore

advisable to examine the bowel for several feet beyond the one sutured. Any ulcers of which the bases appear to be extremely thin, should be sequestered with a few silk sutures. The peritoneum in the neighbourhood of the sutured bowel should then be gently cleansed with dry swabs, and the abdomen closed. If there has been very little leakage, drainage need not be employed, but if doubt arises as to the necessity for drainage it is better to employ a tube or 'cigarette' (Fig. 63). On no account should extensive lavage be employed, because, in addition to the reasons detailed in the section dealing with appendicitis, the patient is not in a condition to stand any extensive manipulation.

*(c) Perforation consequent upon Intestinal Obstruction*

There is little to be said on this point. It is a late complication, and often merely the terminal event, in a neglected case of obstruction, and what has been said regarding the treatment of gangrenous bowel under that heading applies to the cases in this category. The peritoneal cavity may be found flooded with intestinal contents, and in this case lavage of the lower part may be tried as a forlorn hope. But every effort should be made to avoid interference with the upper part of the peritoneal cavity, which may have escaped contamination owing to the tendency of fluid to collect in the flanks and pelvis. If the upper part is already affected, or if infection is carried there by injudicious lavage, the case is almost hopeless.

#### 4. ACUTE APPENDICITIS

On the much discussed question as to when to operate for acute appendicitis we can only here give our own views, and we believe those views to be in harmony with those of the great majority not only of surgeons, but also of physicians of the present day.

At the onset and within the first twenty-four or forty-eight hours of an attack of appendicitis it is impossible to know what is the state of the appendix and it is equally impossible to foresee the course and termination of the case. In such circumstances he who counsels delay in operating takes upon himself a responsibility which he is not justified in undertaking. The operative mortality at this early stage is no greater than that of interval appendicectomy, but even if it were appreciably higher its risks would still be much less than those of procrastination. Very many cases do of course recover spontaneously, but the



patient still has before him the choice between an interval operation and the risk of future attacks.

It is the plain duty of the practitioner to put these facts clearly before the patient and his friends, upon whom, if operation is refused, the responsibility must rest.

When this early and favourable stage has passed, and the third, fourth, or fifth day of the illness has been reached, there is more room for difference of opinion regarding the necessity of immediate operation. It is also to be noted that the practitioner is often not called in to see the patient until the third day or even later. We venture to summarize the position by dividing these later cases into three main groups.

(a) The symptoms are abating, the pulse rate is 90 or under, the temperature is only slightly raised, the tongue is moist and moderately clean, the abdomen is moving with respiration, there is little or no intestinal distension, the bowels have acted, and there is slight local tenderness with or without a definite mass.

(b) There is no change for the better, the pulse is accelerating, the temperature is high, the tongue is foul, the bowels remain unopened, the abdomen moves badly or not at all with respiration, and great tenderness persists, or a mass can be felt either in the right iliac fossa or *per rectum*.

(c) There is definite change for the worse; the temperature is falling whilst the pulse-rate is accelerating, distension is increasing, rigidity and loss of abdominal respiratory movements are becoming more marked, and the patient's facial expression is becoming pinched and anxious.

In (a) the case may safely be left; in (b) there is still a chance of spontaneous recovery, though abscess formation is the more likely, and we ourselves should not hesitate to operate; in (c) there is no question but that immediate operation is imperative.

The *treatment* of appendicitis will be considered under four headings.

(i) Non-operative treatment of those cases in which for one reason or another operation is postponed or refused.

The patient must be kept in bed and his diet restricted to milk. Hot fomentations, or an ice-bag, should be applied to relieve the pain. Opium should not be given if it can possibly be avoided. It is very desirable that the bowels should be well opened, and especially the cæcum and ascending colon; a soap and water enema may be given, but if the result is not satisfactory, castor oil in drachm doses repeated every three hours will ensure a result. Should the symptoms alter and the case assume the

appearances described above under (b) or (c), surgical treatment becomes essential.

(ii) *Early operation.* This differs in no essential respect from an 'interval' operation. An incision is made over the right rectus below the umbilicus, parallel with and about an inch from its outer border. The rectus sheath having been opened, the muscle is retracted inwards and the peritoneum opened. Its mesentery having been ligatured and divided, a ligature is tied round the appendix close to the cæcum. The appendix is then cut off, and its stump buried in the cæcal wall by Lembert's sutures. Any fluid in the neighbourhood is then gently soaked up with strips of dry gauze, and the abdomen is closed. Drainage is not necessary as a rule, but if any doubt of its advisability is entertained a 'cigarette' drain may be employed for a day or two.

(iii) *Operation for appendicitis with diffuse peritonitis.* By diffuse peritonitis is meant a spreading peritonitis unlimited by adhesions, which may, at the time of operation, involve only a small area of peritoneum, or may be spread far and wide over its surface. It may be found to have started (a) from an inflamed but as yet unperforated appendix; (b) from a gangrenous or perforated appendix which is in no manner shut off from the general peritoneal cavity; (c) from an imperfectly shut off abscess; (d) or from a leaking or ruptured abscess.

Any attempt at localization indicates a certain degree of resistance to the infection, and consequently the prognosis in class (c) or (d) is, other things being equal, considerably more favourable than in class (a) or (b). It must be remembered, however, that the nature and extent of the peritonitis can only be ascertained by a bacteriological examination of the peritoneal surface at various points.

The operation may be dealt with under four headings:—

(a) *Opening the abdomen.* The best incision is through the right rectus below the umbilicus (see p. 238). This incision gives access to the appendix in whatever position it may be lying, is capable of enlargement to any desired extent should difficulty be encountered, and is convenient for drainage should that procedure be considered advisable.

(b) *Removal of the appendix.* The removal of the focus of infection is naturally the most important part of the operation. As soon as the peritoneum has been opened, a number of fairly large gauze strips should be gently inserted between the abdominal wall and the cæcal region, before the appendix is sought for. The reason for thus isolating the field of operation is to prevent the

diffusion of infective material from the appendix region on disturbance of the intestines around it. Having isolated the immediate field of operation as completely as possible, the cæcum should be identified, and gently pulled towards or out of the wound. By tracing down the anterior muscle-band on its surface, the appendix will be reached in whatever position it may happen to be lying. There is no excuse for not finding the appendix, and practice will enable it to be found with little disturbance of neighbouring parts. When the appendix has been found, and its mesentery clamped and divided, it is to be cut off close to the cæcum, after tying a ligature round its base. If possible, a few stitches should be put in so as to bury the stump in the cæcal wall; but this is not essential, and should not be attempted if by so doing valuable time would be lost.

(c) *Treatment of the peritoneum.* This has undergone a striking modification within the past few years, and with a gratifying reduction in the mortality. Both the results, and the scientific explanation of certain of the factors concerned in peritonitis, have totally discredited the heroic treatment of diffuse peritonitis by copious lavage of the peritoneal cavity, whether assisted or not by evisceration. The following figures, recently compiled by C. Nitch, show this at a glance: 119 cases were treated by general irrigation, with 98 deaths, a mortality of 82 per cent; 83 cases were treated by dry sponging or strictly limited irrigation, with 6 deaths, a mortality of only 7 per cent.

After removal of the appendix, then, the exudate in its immediate neighbourhood is to be mopped away with dry sponges or strips of gauze, special attention being paid to the pelvis and the right kidney pouch. The rest of the peritoneum is to be left severely alone, for the turbid exudate in the upper part is not pus, but a protective fluid rich in phagocytes, upon whose integrity and activity the chances of recovery depend. General irrigation not only washes them away, but also spreads the pathogenic bacteria over previously uninfected parts of the peritoneum.

The question of *drainage* now arises. In many cases it is quite unnecessary, but as considerable experience is required to decide this point it is best, if any doubt is felt, to be on the safe side by employing drainage for two or three days. This may be done either by leaving a wide rubber tube through the partially closed abdominal wound reaching down to the site of the removed appendix, or through a small incision made in the loin for the purpose. In either case, it is well to place a small gauze strip down the whole length of the tube, to act as a capillary drain,

and to prevent the tube from becoming blocked. This 'wick' can be easily and frequently changed without disturbing the tube.

(d) *After-treatment.* The patient must be returned to bed, and collapse treated by hot bottles, stimulants, and, if necessary, saline infusion. The method of continuous rectal infusion suggested by J. B. Murphy, and described in Chapter I, has been used with apparent success in some cases. It is, however, not easy to manage, and often causes so much discomfort that patients will not tolerate it. If large quantities of fluid are required, they can be administered either by the natural channel of the mouth, provided that vomiting is not severe, or by one of the other methods of saline infusion discussed in Chapter I.

The *action of the bowels* is an all-important matter. The bowel is the great channel of elimination of poisons in these cases, and this function should be encouraged by every possible means. As soon as the patient is able to swallow, he should have from three to five grains of calomel, followed by drachm doses of sulphate of magnesia every two hours, until free action of the bowels is obtained. Enemata containing turpentine are often useful in starting evacuation and in relieving distension by assisting the passage of flatus. In this connexion the constipating action of morphia must be remembered.

The *posture* is also important; the patient should be placed upon his back with the head and shoulders well raised, and, if drainage tubes have been used, slightly inclined towards the right side. Some surgeons advocate what is practically a sitting posture, with the idea of encouraging the flow of exudate towards the pelvis, and so diminishing the chances of subphrenic abscess.

*Vomiting* is treated by 'auto-lavage' of the stomach, namely, by allowing the patient to drink from half a pint to a pint of hot water at once, and then to bring it up again. This often gives much relief. If he retains the fluid, so much the better. The lavage may be followed by repeated small doses of cocaine (one-eighth grain), or repeated doses of one minim of tincture of iodine.

*Morphia* must be withheld if possible, because it tends to inhibit the intraperitoneal phagocytosis already mentioned. Other sedative drugs are therefore to be preferred, such as potassium bromide, which may be administered by the mouth, or, if vomiting prevents this, by the rectum.

*Anti-colon bacillus serum* is now a commercial product, and, used as a means of combating the dangerous toxæmia of these

cases of colon bacillus peritonitis, has proved a valuable adjunct to the other means of treatment. This serum, which is multi-valent, should be injected subcutaneously, or given by the rectum, in doses of from 30 to 50 cubic centimetres, repeated at intervals of from eight to twelve hours. Its action appears to be almost entirely antitoxic. As a rule, within half an hour of its administration the patient experiences a sense of comfort, the pulse slows, and vomiting ceases. The results obtained are sufficiently encouraging to warrant its more extensive employment.

(iv) *Local abscess.* Two varieties which are important from the operator's point of view may be encountered :—

(a) Where the abscess is in contact with the abdominal wall in such a position that it can be evacuated without opening the general peritoneal cavity.

(b) Where the evacuation of the abscess necessitates traversing the general peritoneal cavity.

In the former case the incision is placed at the most prominent part of the swelling, and the pus reached by separating the abdominal muscles in the direction of their fibres.

In the latter case the abdomen is first entered as near to the abscess as possible, and this opening is usually made most conveniently through the right rectus muscle. Several long strips of sterile gauze are next inserted in such a manner as to isolate the abscess from the general peritoneal cavity, and to absorb any pus which would otherwise tend to soil the peritoneum around. The abscess is then opened into with the finger, and the escaping pus rapidly wiped away with sponges. The cavity must next be dried as thoroughly as possible with strips of gauze, the appendix sought for and removed, and a drainage tube inserted. The guarding strips of gauze are now removed, and the wound closed, leaving the drainage tube projecting from it. It must be admitted that this mode of dealing with an abscess is not one which commends itself to all surgeons, and therefore it is desirable to give the grounds upon which we advocate it.

(i) The fact of localization indicates a considerable degree of resistance on the part of the peritoneum. Beyond the limits of the abscess there is always a certain amount of exudate rich in phagocytes, so that the peritoneum is on the defensive, and is prepared to deal with the small amount of pus which may, during the manipulations, soil it in the immediate neighbourhood of the abscess.

(ii) The colon bacillus tends to die out in an abscess, and

although the pus may be extremely offensive, yet its infectivity is in most cases comparatively slight.

(iii) The removal of the appendix takes away the source of the infection, obviates subsequent complications, and does away with the necessity of a second operation.

(iv) Experience shows that the mortality after this operation is no greater than after other methods of dealing with such an abscess.

In this connexion statistical figures are unreliable, because the degree of localization of an abscess is subject to great variation, and no doubt many cases, regarded clinically as localized abscesses, are in reality examples of partial or imperfect localization accompanied by diffuse peritonitis. This indeed is not infrequently shown by the post-mortem examination.

Whilst, however, the above is to be regarded as the ideal treatment, there are cases in which a search for the appendix would mean such a prolonged operation, and such disturbance of adhesions, that its removal would be with advantage postponed until a later date. Such would be the large, very definitely localized abscesses which have been long in forming. As a general rule, the shorter the history and the smaller and less perfectly localized the abscess the stronger is the indication for the ideal operation described above.

*After-treatment.* Owing to the uncertainty as to the degree of localization, and the possibility of some amount of diffuse peritonitis around, the same necessity exists for prompt evacuation of the bowels and the withholding of morphia as in the cases of diffuse peritonitis. Anti-colon bacillus serum may sometimes be used with advantage. The drainage tube should not be retained too long; as a rule a few days are ample, after which a gauze drain should be substituted. If the appendix has not been removed, a second operation for this purpose is imperative, for the old idea that an attack of appendicitis which ends in supuration is curative has long since been shown to be untenable. In the St. Thomas's Hospital series already referred to there were 49 examples of appendices removed at a second operation subsequent to the incision of the original abscess, but there was no single instance in which the organ could possibly be described as obliterated, or regarded otherwise than as a source of danger to its possessor. In the same series there were 16 cases of appendicitis recurrent after abscess, of which 6 were acute attacks, 9 recurrent abscesses, and one case of diffuse peritonitis.

### 5. PERITONITIS FROM OTHER CAUSES

Pathological conditions of the female pelvic organs are not infrequently the cause of acute peritoneal infection. Some, such as acute changes in ovarian cysts, may be readily recognized; others are difficult of diagnosis, and may easily be mistaken for acute intestinal lesions. The symptoms in these cases very closely resemble those presented by an acute abdominal disease of intestinal origin.

The most important factor in any case is the nature of the micro-organisms concerned in the peritonitis; and it may be said at once that those found in salpingitis and pyosalpinx are, in the great majority of cases, of the mildest type. Indeed, the pus in a pyosalpinx is actually sterile in more than half the cases, whilst in the remainder it is rare to find any other organism than the gonococcus.

On the other hand, the peritonitis resulting from infection of ovarian cysts, or from puerperal cases, may be of the most virulent type, such as is caused by the colon bacillus or the streptococcus pyogenes. These several conditions, in so far as they bear upon the surgery of acute abdominal disease, will now be considered separately.

#### *(a) Changes in Ovarian Cysts*

Suppuration, rupture, hæmorrhage, or torsion of the pedicle may all give rise to sudden and urgent symptoms. It is true that in some of the less severe cases the symptoms subside without operation, but such an outcome cannot be relied upon, and delay may entail hopeless involvement of the peritoneum. Operation should therefore be proceeded with at once.

*Operation.* The abdomen is opened through one or other rectus muscle below the umbilicus, and the condition of the cyst ascertained. In cases of twisted pedicle, or of intracystic hæmorrhage, it is sufficient to remove the cyst and close the abdomen. The clear or blood-stained fluid which is almost always present in the peritoneal cavity is at least harmless, and may be protective, and no attempt should be made to remove it. If, on the other hand, the cyst has burst and has flooded the peritoneal cavity, as much of the fluid as possible should be absorbed with sterile gauze before the abdomen is closed.

If the cyst has become infected and has given rise to a purulent peritoneal exudation, either by rupture or gangrene, the outlook is very serious, because in some cases a streptococcus pyogenes

and in others a colon bacillus has been found in the exudate. Here the same principles of treatment apply as in the case of peritonitis resulting from appendicitis, namely, removal of the source of infection and dry sponging of the peritoneum. If drainage is considered advisable, it may be provided for by a tube passed into Douglas's pouch through an incision in the posterior vaginal fornix.

#### (b) *Affections of the Fallopian Tubes*

As has already been stated, the micro-organisms concerned in the peritonitis arising from salpingitis are, as a rule, of a mild type, although occasionally, doubtless, more virulent organisms reach the peritoneum along the Fallopian tubes. The pneumococcus, for example, has been known to reach the peritoneal cavity from a pyometra.

Gonorrhœal peritonitis is most frequently of a chronic and local character, attended by the formation of adhesions in the pelvis, but it may be acute and diffuse. There are two circumstances in which the surgeon may be called upon to operate on account of urgent symptoms, namely, the rupture of a pyosalpinx, and an acute diffuse gonorrhœal peritonitis.

(i) *Rupture of a pyosalpinx.* The symptoms to which this accident give rise are those of shock, attended by abdominal pain, rigidity, and vomiting. But as the toxins absorbed are not so virulent, the patient is far less ill than in the case of a similar accident to the appendix vermiformis.

*Operation.* This consists in removal of the pyosalpinx and the cleansing of the pelvic peritoneum, either by dry sponging or local irrigation. As the condition is frequently bilateral, it is usually advisable to remove both tubes. There is no necessity to employ drainage.

(ii) *Acute diffuse gonorrhœal peritonitis.* The onset is usually sudden, but not very severe, and the succeeding symptoms are those of a mild peritonitis. It is not a common form of peritonitis, and when it occurs the case is likely to be mistaken for one of perforated gastric ulcer. Undoubtedly such a case may recover without operation, and if the diagnosis could be made with certainty it might be advisable in some cases to delay active measures. But operation is usually the safer course. It will, moreover, cut short the illness and prevent such complications as might afterwards arise from adhesions or from the presence of a chronically inflamed Fallopian tube.

*Operation.* When the abdomen is opened a quantity of clear,



straw-coloured, somewhat viscid, peritoneal exudate is usually found. From the swollen, reddened Fallopian tubes a few drops of pus can be squeezed. The tubes should be removed, the peritoneal exudate either sponged or washed away, and the abdomen closed. Here, again, drainage should not be employed.

(c) *Pneumococcal Peritonitis*

As a complication of some other acute pneumococcal infection, peritonitis from this cause has little surgical interest. Cases, however, occur in which the peritonitis is, if not the primary, at any rate the most prominent feature of a case of pneumococcal infection. Such peritonitis may manifest itself either as a localized intraperitoneal abscess or as a series of abscesses, insidious in onset and likely to be diagnosed as tuberculous peritonitis. It occasionally happens, however, that a pneumococcal peritonitis has a sudden and acute onset, demanding for its relief instant operation. There are no positive distinguishing signs by which such a case can be recognized; it is likely to be diagnosed as one of acute appendicitis; indeed, in rare instances, a pneumococcal appendicitis may be the primary lesion. The condition may be suspected if, on opening the abdomen, no gross lesion is found to which the peritonitis can be definitely attributed, and if the exudate is of a greenish purulent character without offensive smell. The nature of such a case can only be definitely decided by a bacteriological examination.

*Operation.* The best chance of recovery appears to rest upon thorough lavage of the peritoneal cavity with sterilized saline solution; but it must be remembered that children, in whom this particular affection is more common than in adults, bear any intraperitoneal manipulation badly.

(d) *Acute Pancreatitis*

The terms hæmorrhagic, gangrenous, and suppurative are often added to that of acute pancreatitis, to describe the most prominent appearances presented by the organ which is the subject of this acute infective condition. Many cases are rapidly fatal from shock and peritonitis, but others may survive for several days, with the formation of a pancreatic abscess, and others again, less acute still, may recover.

The diagnosis, generally speaking, is only made by exploratory cœliotomy, for the case is most likely to be considered one of

intestinal obstruction, or perforation of the gall-bladder, the stomach, or the duodenum. A characteristic case of acute pancreatitis would present the following features. A patient, most often a man of middle age, previously healthy, is suddenly seized with the most intense pain, at first epigastric, but soon becoming diffused over the abdomen. The symptoms of shock are extreme; vomiting is an early and marked feature; constipation is present, although it may not be absolute; the abdomen is rigid and soon becomes distended. The abdominal distension is first noticeable in the upper part, and there may be a spot of most acute tenderness above the umbilicus. Occasionally jaundice has been noted. The symptoms, in fact, are those of what has been termed 'peritonism' in its most acute form, and such that, unless the patient is *in extremis*, an operation is urgently called for.

*Operation.* When the exploratory opening has been made, a little blood-stained fluid may be found in the peritoneal cavity, and fat necrosis may be present. This is shown by the presence of numerous opaque white spots in the fat of the abdominal wall, the omentum, and the mesentery. A diffuse swelling will be felt in the region of the pancreas. If the nature of the case is thus recognized the abdomen should be closed. The future conduct of the case is subject to considerable difference of opinion. Undoubtedly some patients have recovered after such an exploration without anything further being done: others have survived a few days and succumbed to peritonitis spreading from suppuration in the pancreas. It is probably best to attempt to avoid such a termination by immediate drainage of the pancreatic region from behind. For this purpose the patient is turned upon the face, and a vertical incision made at the outer border of the erector spinæ below the last rib on the left side. The pancreas is thus exposed retroperitoneally, and by a route convenient for drainage; by this means extension of the inflammation to the peritoneum may be avoided. An alternative method is to make an opening through the gastro-colic omentum, pack off carefully with gauze, incise the pancreas and insert a large drainage tube.

#### (e) *Cholecystitis*

Acute inflammation of the gall-bladder, with or without the presence of gall-stones, is sometimes a cause of acute abdominal symptoms, and gangrene, perforation, or rupture of such a gall-bladder may, on exploration, be found to be the origin of the

peritonitis. These conditions are strictly comparable with the corresponding changes so frequently associated with acute inflammation of the appendix, and the treatment must be carried out on similar lines.

(i) *Empyema* of the gall-bladder with surrounding peritonitis. The distended gall-bladder must be brought up to the abdominal wound, and very carefully and completely isolated by gauze packing from the general peritoneal cavity. It must be incised, emptied of pus and of any gall-stones that may be present and drained by a tube stitched into the incision by means of a purse-string suture. This done, any fluid which may have been found around the gall-bladder must be removed by swabbing gently with dry gauze, and a second drainage tube should be inserted alongside the gall-bladder. The wound should then be sutured, leaving the two tubes projecting from it. The tube alongside the gall-bladder should be removed in forty-eight hours : that in the gall-bladder will come away in a few days, and the biliary fistula thus established will, if no duct obstruction be present, close spontaneously. Should it fail to do so after two or three weeks, further operation will be necessary.

(ii) *Perforation and gangrene* of the gall-bladder. If these conditions are found, the viscus must be brought up to the wound, packed off, and emptied. The gangrenous portion must then be cut away and the remainder sutured around a drainage tube, the operation being concluded as in the previous section. The outlook in such cases is naturally extremely grave, though early operation certainly affords a chance of recovery.

#### (f) *Ruptured Abdominal Hydatid.*

Acute abdominal symptoms occasionally occur as the result of the sudden escape of the contents of a ruptured hydatid cyst into the peritoneal cavity. Barling and Welsh have recorded six such cases in which the diagnosis was made by the association of acute abdominal symptoms with the presence of free fluid in the peritoneal cavity, eosinophilia, and urticaria.<sup>1</sup>

#### (g) *Localized Intraperitoneal Suppuration*

1. *Subphrenic abscess.* This form of intra-abdominal abscess is mentioned separately because of the frequent difficulty of diagnosis and the special method by which it has to be opened and drained. The common causes are localized perforations of the

<sup>1</sup> *Lancet*, October 1, 1910.

stomach or duodenum, appendicitis, and lesions of the biliary passages. In appendicitis the pus travels upwards alongside the ascending colon. It also occurs as a 'residual' abscess after a diffuse peritonitis.

A subphrenic abscess may be situated between the liver and the right wing of the diaphragm, around the spleen in the left cupola, or around the kidney in the right renal pouch. An abscess on the right side raises the diaphragm and depresses the liver. As the pus accumulates the elevation of the diaphragm is increased and the base of the right lung becomes collapsed. These two factors combine to produce a considerable extent of percussion dullness at the base of the chest, and this, together with absence of air entry and diminution of vocal fremitus and resonance, often gives rise to the diagnosis of simple pleural effusion or of empyema. Pleural and subdiaphragmatic friction are also not uncommon, especially in the earlier stages. Pain and tenderness may be present over the lower ribs; this is well shown by compressing the chest from side to side or from front to back. Pain in the shoulder is very common. The onset may be acute, but is sometimes gradual and indefinite, accompanied by irregular temperature and by the general signs of suppuration. These signs and symptoms, particularly in a young woman with a history pointing to gastric ulcer, or arising in the course of an attack of appendicitis, are almost pathognomonic of a subphrenic collection of pus. It might be supposed that the rounded shape of the diaphragm would give rise to a rounded upper margin of dullness, and when present this is helpful, but this sign is often lost owing to the presence of a concomitant pleural effusion.

When the abscess is due to the perforation of a gastric or duodenal ulcer it is not uncommon for gas to be present in addition to pus, and the physical signs are somewhat different. The liver dullness over the lower ribs may be diminished or absent; a definite coin sound can be elicited, and the resonance shifts on alteration of the position of the patient. Thus, with the patient on his back, a resonant area may be present over the lower ribs between the nipple line and the xiphisternum, extending upwards for two or three inches above the costal margin, whilst the note in the lower axilla is dull; but on turning him on to his left side dullness appears in the region previously resonant, and resonance appears in the lower axilla now uppermost.

A screen examination with the X-rays sometimes proves of assistance in cases of subphrenic abscess by indicating the level and degree of mobility of the diaphragm.

On the left side the pus collects in the potential space bounded by the diaphragm above, the falciform ligament internally, the left lobe of the liver and the costo-colic fold below, the spleen externally, and the abdominal wall anteriorly. The physical signs are similar to those seen in a right-sided subphrenic abscess; gas may also be present, but the physical signs due to the presence of gas may be rather indeterminate owing to the difficulty of distinguishing them from those due to a distended stomach. It is worthy of note that the falciform ligament forms a fairly effectual barrier to the extension of the pus from one side to the other, the presence of pus in both subphrenic regions being very exceptional.

*Treatment.* Exploratory puncture with an aspirating needle cannot be too severely condemned. It is far more dangerous than an open exploratory operation, and, if negative, is quite valueless. Further, owing to the fact mentioned above, that a simple pleural effusion may coexist with a subphrenic abscess, the results of an exploratory puncture may nullify an otherwise correct diagnosis and cause delay in operation. We have several times seen this coexistence of clear fluid above the diaphragm and pus below.

*Operation.* The patient lies upon the opposite side, and an oblique incision, some five inches in length, is made, beginning in the mid-axillary line and crossing the ninth, tenth, and eleventh ribs at right angles. The soft parts being retracted, portions of two ribs are excised for about three inches each, as in operating upon an empyema. The pleural cavity, if not already obliterated by adhesions, is then opened just above the line of reflection of the parietal pleura upon the diaphragm, which at this point rises almost vertically upwards. The presence of clear fluid in the pleural cavity above a subphrenic abscess makes no difference to the subsequent steps, but if pus is found it opens up the possibility either that the case is really one of localized empyema or that the subphrenic pus has made its way through the diaphragm. It is, of course, possible to have pus both above and below, without any visible perforation in the diaphragm, but such a remote possibility does not warrant anything further being done at this stage. It is better to leave in a drainage tube and await events.

If only clear fluid or nothing at all is found in the pleural cavity, then the surgeon proceeds to explore below the diaphragm. The diaphragmatic pleura is divided, and the lips of this incision are united by a continuous suture with the cut edges of the parietal pleura, so shutting off the pleural cavity (Fig. 64). Next, the diaphragm and diaphragmatic peritoneum are incised and the

abdominal cavity opened. Often the abscess will be encountered at once, but if this is not the case the finger must be gently inserted and moved about until the pus is reached. A drainage tube is then introduced and the wound partially closed.

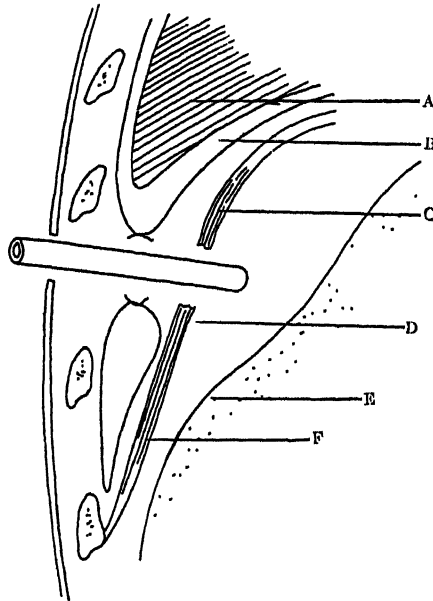


FIG. 64. Diagram of structures traversed in opening a subphrenic abscess. A, Lung ; B, Pleural cavity ; C and D, Diaphragm ; E, Liver.

2. *Subhepatic abscess.* A collection of pus may occupy a potential space known as the right kidney pouch. C. R. Box gives its boundaries as follows :—above and in front the right lobe of the liver and its ligaments ; below, the hepatic flexure of the colon and its attachments to the posterior abdominal wall ; internally, the peritoneum covering the descending duodenum and lumbar spine and stretching forwards to the foramen of Winslow ; externally, the parietal peritoneum of the lumbar region. The peritoneum covering the right kidney forms the floor of the pouch. This space can accommodate a very large collection of pus.

The ordinary causes of abscess in this region are, ulcer of the duodenum, appendicitis, lesions of the gall-bladder, and, less commonly, perforation in malignant disease of the hepatic flexure of the colon.

The physical signs are not quite so characteristic as in the case of an abscess situated between the right lobe of the liver and the

diaphragm, but with a large collection of pus the liver may be pushed upwards, and similar though more limited signs may be found in the lower thoracic region. Further, the liver edge is pushed upwards as contrasted with its depression in a supra-hepatic abscess, but owing to adhesions this cannot always be relied upon, and the presence of pain and tenderness makes this sign somewhat difficult to elicit.

There is usually considerable deep tenderness below the right costal margin; the temperature and general condition are suggestive of suppuration; there may be, as described above, certain physical signs at the base of the right lung; and finally the presence of a history suggestive of duodenal ulcer or of appendicitis, or a discharging sinus resulting from some recent operation, should indicate the probable nature of the condition.

3. *Hepatic abscess.* The multiple abscesses of portal pyæmia and suppurative cholangitis are beyond the reach of surgery, but the large solitary abscess found in connexion with dysentery or suppurating hydatids may be reached and drained successfully. The diagnosis in a well-marked case is easy, the main features being hypochondriac pain, enlargement of the liver, possibly with bulging of the chest wall, irregular fever, rigors and emaciation. The abscess seldom occupies such a position that it can be reached through an incision below the costal margin, but if it should do so the treatment becomes relatively simple. Generally it must be opened through an incision similar to that described above for subphrenic abscess, traversing both pleural cavity and diaphragm. When the liver has been exposed, a small area of its surface is isolated from the peritoneal cavity with gauze packing, and the substance of the liver is explored in various directions with a trocar until pus is encountered. The track of the trocar is then enlarged by a cautious incision and a drainage tube inserted. If the abscess proves to be hydatid in origin it is necessary at the same time to evacuate the contents of the cyst. Some surgeons prefer to divide the operation into two stages.

4. *Perinephric abscess.* An acute abscess situated around the kidney and arising from disease of the kidney itself will be situated behind the peritoneum. But extension of suppuration from intraperitoneal disease, such as that of the appendix, may cause a localized abscess around the kidney. In either case the pus is to be reached by the same route, namely, by the lumbar incision described on p. 328.

5. *Other forms of intra-abdominal abscess.* The most common

variety, namely, that due to appendicitis, has already been dealt with. Other less common causes are : disease of the female pelvic organs ; localized collections about a cancerous growth of the bowel ; localized collections around a perforated gastric or duodenal ulcer, or around an inflamed gall-bladder ; and localized pneumococcal peritonitis. ' Residual ' abscesses may occur after the subsidence of a diffuse peritonitis, or after any abdominal operation which involves opening the bowel.

The diagnosis rests upon the presence of an intra-abdominal mass, with pain, tenderness, localized rigidity of the abdominal muscles, and the constitutional signs of suppuration. Its probable cause will be indicated by its position and the clinical history.

From the point of view of treatment, two kinds of intra-abdominal abscess may be met with. In the one the abscess is in contact with the abdominal wall, so that it may be incised without opening the peritoneal cavity ; in the other the general peritoneal cavity must of necessity be traversed in order to reach the pus.

*Operation.* The incision must be placed as directly over the mass as possible, and the abdominal muscles traversed in the direction of their fibres. If the abscess is in contact with the abdominal wall, the pus will escape as soon as the peritoneum has been incised, and it is only necessary to insert a drainage tube. If, when the peritoneum has been incised, it is found that the free peritoneal cavity has been opened, very careful packing with gauze strips must be done in order to wall off the path along which the pus will escape. When this has been done, the abscess is gently broken into with the finger, and the drainage tube inserted. The gauze strips are best left undisturbed. After a few days they will become loose and can be removed, perhaps a little at a time from day to day, for by that time the track of the tube will have become securely shut off from the general peritoneal cavity by adhesions. Unless the abscess has been a very large one, the tube should be removed altogether after three or four days and its place taken by a gauze strip, for the cavity of an intra-abdominal abscess usually becomes obliterated very rapidly by the pressure of the viscera.



## CHAPTER XIV

### AFFECTIONS OF THE DIGESTIVE SYSTEM

#### 1. ACUTE DIARRHŒA AND VOMITING OF INFANCY

A mild attack of diarrhœa in an infant may terminate spontaneously by the expulsion of the irritant or undigested food which caused it or may yield promptly on the administration of a dose of castor oil. In severer cases of more definite gastro-enteritis or ileo-colitis, the loss of fluid caused by the diarrhœa, and the vomiting which nearly always accompanies it, produces the most profound depression, due also no doubt in part to the toxins of the pathogenic organism responsible for the attack. The child wastes rapidly, the fontanelle becomes depressed, the face pinched and the eyes sunken ; in fact its condition may become most precarious in as short a time as twenty-four hours. The abdomen is often retracted, but in some cases it is somewhat distended, and in cases in which the large bowel is affected there may be definite tenderness along the course of the colon, tenesmus occurs, and the stools may contain both blood and mucus.

In the much more acute and fortunately rarer condition known as *cholera infantum* a previously healthy child may be in a dying condition in twelve hours.

The presence of blood and mucus in the stools may raise the suspicion that the case is one of intussusception. This possibility should never be hastily excluded and a fairly prolonged examination of the abdomen should be made, chloroform being administered if necessary. Even if no tumour be felt it must be remembered (1) that an intussusception may be hidden beneath the liver, and (2) that it is often only palpable when the bowel involved undergoes contraction. A rectal examination should never be omitted.

#### • *Treatment of Infantile Diarrhœa*

(a) *Treatment of the collapse.* If the symptoms are very severe, with marked collapse, sunken eyes, depressed fontanelle, and retracted abdomen, subcutaneous infusion of 6 or 8 oz. of normal saline should be performed (see p. 15). This procedure takes from half to three-quarters of an hour, and whilst it is

going on strychnine may be administered hypodermically. To an infant of three to four months, half a minim of the liquor strychninæ may be given; to an older infant, one minim. Small doses of brandy may be given by mouth at the same time, 10 to 20 minims in a little water every hour for a few hours. As the extremities are frequently blue and cold, the infant should be warmly wrapped up.

(b) *Gastric and intestinal lavage.* After the urgent symptoms of collapse have been treated, and if vomiting is a prominent symptom, the stomach should be washed out. Similarly, if the colon is involved, as shown by the presence of mucus and blood in the stools, it also should be washed out with saline solution. A soft rubber tube of small bore should be used and passed well into the colon. The douche-can should not be raised more than two feet, and the irrigation should be continued until the washings are clear. This may be done two or three times in the first twenty-four hours, and daily afterwards if necessary.

(c) *Feeding.* After the above measures have been adopted, in whole or in part according to the severity of the case, the feeding should be attended to. Little or no food should be given for twenty-four or forty-eight hours, and, above all, milk should be withheld. Boiled water may be given in teaspoonful doses, or albumen water, or weak veal or chicken broth in similar quantities. After twenty-four or forty-eight hours whey may be given, and egg-white may be added to it. If the vomiting does not stop, nothing should be given but plain water, and the loss of fluids made up by repeating the subcutaneous injections of saline.

(d) *Drugs.* At the beginning of the attack a dose of castor oil should be given to clear out the alimentary canal. This may be poured down the œsophageal tube after the stomach has been washed out, or two grains of calomel may be placed on the tongue. If, however, the diarrhœa has already been profuse before coming under treatment, the initial purge may be omitted.

Opium is the most valuable drug, but it must be given in minute doses to children. Dover's powder may be given in doses of  $\frac{1}{8}$  gr. at three months,  $\frac{1}{4}$  gr. at six months, and  $\frac{1}{2}$  gr. at one year, every six hours. Castor oil in small doses has a constipating effect, and the opium may be added to it. Thus, *ol. ricini*  $\mathfrak{m}$  *v*, *mucilag. acaciæ*  $\mathfrak{m}$  *xv*, *aq. anethi*  $\text{ad } \overline{5}$  *j*, forms an excellent mixture, to which *tinct. opii* may be added— $\mathfrak{m}$   $\frac{1}{4}$  for a child of three months,  $\mathfrak{m}$   $\frac{1}{2}$  for six months, and  $\mathfrak{m}$  *j* for one year. This mixture may be given every six hours. A child should not be awakened

for a dose of medicine containing opium, as his sleep may possibly be partly the result of previous doses of opium, and an overdose may result.

If this treatment fails to stop the diarrhoea, or if vomiting persists, bismuth should be tried. It should be given in large doses, either as a mixture containing 5 grains for an infant a month old, 10 grains for one of six months, with tinct. opii according to the age; or, as a powder combined with calomel, gr.  $\frac{1}{8}$ , and Dover's powder as above. The mixture or the powder should be given at least every six hours.

If the diarrhoea becomes chronic, astringent drugs should be tried, such as catechu, mistura cretæ, and finally nitrate of silver in doses of a twelfth to a sixth of a grain.

## 2. CYCLIC OR RECURRENT VOMITING

Although this is a somewhat rare affection it is very distressing and occasionally fatal. It seems to be confined to children. The attacks are sudden in onset, though occasionally there is a little prodromal malaise or headache; they bear no relation to food and consist primarily of incessant vomiting. The child wastes rapidly, the tongue becomes dry and cracked, and thirst is intense, but any fluid taken by the mouth is promptly vomited. Slight fever may occur. The bowels are constipated and the abdomen is retracted. Within about twenty-four hours of the onset the breath smells strongly of acetone, and the urine yields the red colouration with ferric chloride solution which is indicative of the presence of diacetic acid. The attacks usually last from one to three or four days, but sometimes ten days or even longer. About a dozen fatal cases have been recorded, and in nearly all of them the liver has been found to be extremely fatty. It is impossible to discuss here the nature of this interesting condition, but the active starvation which is brought about by the severe vomiting is probably sufficient to account both for the acid poisoning and the deposit of fat in the liver.

*Treatment.* All food should be withheld from the stomach from the commencement of an attack. Lavage would also alleviate symptoms and might quickly cut an attack short. Rectal feeding with normal saline should be instituted to replace loss of water from the tissues and to relieve the intense thirst. Glucose should be added to the saline, not only as a food, but also because the adequate utilization of fat requires the co-operation of carbohydrates. The symptoms attributable to the

acidosis may be treated by adding bicarbonate of soda to the rectal feeds.

Thus in a child of 5 years one drachm of glucose and one drachm of bicarbonate of soda in 5 oz. of normal saline should be given every six hours. In a severe case subcutaneous injections of saline should also be used. Morphia hypodermically seems to have done good in some cases,  $\frac{1}{30}$  grain for a child aged 2 years,  $\frac{1}{20}$  grain for a child of 3 to 4 years,  $\frac{1}{12}$  grain at 6 years. If nothing relieves the attack the advisability of an exploratory laparotomy should be considered. We have seen one case in a boy aged 4 years and 9 months in which death occurred and pyloric stenosis was found at the autopsy.

### 3. ACUTE DILATATION OF THE STOMACH

This grave but fortunately not very common affection occurs under a variety of conditions. It may follow abdominal operations of various kinds, but oddly enough it rarely complicates any operation on the stomach itself; it is also seen after operations on the extremities, after injuries whether of the abdomen or head and spine, in severe diseases, especially acute infections such as pneumonia and typhoid fever, and in heart disease.

Its pathology is most obscure; there is probably paralysis of the stomach wall, and another factor, namely, occlusion of the lower part of the duodenum from pressure of the root of the mesentery seems to play a part, though this would appear to be brought about by stretching of the mesentery owing to the intestines being forced downwards towards the pelvis after the dilatation of the stomach. Whilst, therefore, this would accentuate the condition it appears to be secondary to the primary dilatation.

*Symptoms.* The onset is sudden, and is associated with severe vomiting and sometimes with abdominal pain. The vomiting is usually very copious, so much so as to suggest that the fluid is secreted into the stomach. The vomitus at first consists of stomach contents, later of bile-stained fluid or of coffee-ground material which is very offensive though not faecal. The patient rapidly passes into a state of profound collapse.

On examination of the abdomen the outline of the distended stomach is sometimes visible, but disappears after vomiting or lavage. Peristalsis is absent. On palpation the abdomen is tender, firm, and tense. A succussion splash is nearly always

present. Percussion usually shows a very large area of dullness, most marked on the left side.

*Treatment.* Thorough lavage of the stomach is essential, and it is advisable to raise the pelvis so that the fluid in the stomach may be more accessible to the œsophageal tube. This should be done fairly frequently, four or five times daily. Marked relief follows the use of the tube. The patient should also be turned over on to the knee-elbow position as much as possible with the view of relieving the duodenum from the weight of the super-incumbent stomach, and the end of the bed should be raised to relieve any traction on the mesentery from the dropping downwards of the small intestines. No food should be given by the mouth; frequent rectal injections of normal saline will help to relieve the intense thirst. Hypodermic injections of strychnine should also be given. The early recognition of this condition and its active treatment will offer a fair chance of recovery, but when completely developed the outlook is very grave. Gastrojejunostomy has been tried, but with discouraging results.

#### 4. ACUTE ABDOMINAL ATTACKS ASSOCIATED WITH PURPURA, URTICARIA, AND ANGIO-NEUROTIC ŒDEMA

The condition described by Henoch in which recurring attacks of acute abdominal pain and the passage of blood and mucus *per rectum* are preceded by, associated with, or followed by a purpuric cutaneous rash, has long been known, but the affection seems to be more common than is generally supposed.

The pathological condition underlying these attacks is either a hæmorrhagic or a serous effusion into the bowel-wall, and the abdominal symptoms are directly referable to these changes. Little or no pain is experienced when blood is shed into the lumen of the bowel, but severe pain attends any marked effusion into the mucous, muscular, or serous coats. With much infiltration of blood the bowel-wall assumes a firm leathery consistency, and if the hæmorrhage into the mucous coat is severe, sloughing and ulceration may result. The bowel in the vicinity of the ileo-cæcal valve is especially prone to this affection.

*Symptoms.* There is usually sudden abdominal pain and vomiting. The pain is severe and of colicky type with intermissions; abdominal tenderness is not always present, and pressure may actually give some relief. Blood and mucus are usually passed by the bowel; there may be merely a few streaks of blood or several ounces may be passed. There is usually very

little faecal matter, though severe diarrhoea may occur. Anæmia is commonly present, the result of the general hæmorrhagic tendency, further evidence of which is shown in the purpura and the liability to epistaxis, hæmatemesis and hæmaturia. It is not necessary always to assume that the effusion into the bowel-wall is hæmorrhagic, as in some of these cases the abdominal symptoms are accompanied by urticarial or cedematous swellings in other parts of the body and may be due to localized cedema of the bowel-wall.

In mild cases the attacks do not last long, but there is a characteristic tendency to recurrence with intervening periods of fair health. There is a liability to the development of nephritis, and this is ultimately the cause of death in many cases.

In the severer forms the pain is very acute, the abdomen becomes distended and the patient soon presents the symptoms of acute intestinal obstruction. The condition may resemble intussusception very closely, but the cutaneous eruption affords a clue to the nature of the case. Intussusception does, however, occasionally occur, and the presence of a purpuric rash may therefore be actually misleading; some cases have been successfully operated on. It is probable that the thickened bowel acting as an obstruction gives rise to intussusception from spasmodic intestinal contraction behind the obstruction.

*Diagnosis.* The cutaneous eruptions give the clue to the diagnosis in the majority of cases, but when, as occasionally happens, the abdominal symptoms precede the eruption, accurate diagnosis may be impossible. The history of previous attacks with cutaneous rashes would indicate the probable nature of the case, and the occurrence of joint pains is also helpful. Acute abdominal pain coupled with the passage of blood and mucus *per rectum* naturally suggests an intussusception, and unless this condition is borne in mind the presence of a few purpuric spots will easily escape observation. As has been seen, however, intussusception does occasionally occur in the course of the disease and a definite tumour may be palpable, but even this sign may be misleading, as the thickening of the bowel-wall may be so great as to give rise to a definite tumour.

*Treatment.* In mild attacks hot fomentations should be applied to relieve the abdominal pain, and if necessary morphia should be given. Treatment of the underlying blood disorder is not very satisfactory, but good results seem occasionally to follow the use of calcium internally. Ten grains of calcium lactate may

be given to a child three or four times daily. Horse serum often exerts a favourable influence in hæmorrhage, and 10 c.c. should be given hypodermically. The vomiting precludes much feeding and it is wise to give little except milk.

In severe attacks presenting the symptoms of acute intestinal obstruction the problem is much more difficult. If a definite tumour is present it will be wise to operate, as it is impossible to determine beforehand whether it is due merely to thickening of the bowel-wall or whether an actual intussusception is present. If the abdomen is distended or very rigid an anæsthetic may be necessary to determine the presence of a tumour.

### 5. ENTEROSPASM AND MUCOUS COLIC

By the term enterospasm is meant the spasmodic contraction of one or more portions of the intestine. The part involved is converted into a hard, narrow, nearly solid, and pale cord. When the small intestine is affected severe pain and symptoms of acute obstruction sometimes occur; so much so that laparotomy has been performed on this supposition and the nature of the case only recognized by the contracted small bowel.

The colon, however, is affected more commonly than the small intestine, and especially the portions contained in the right and left iliac fossæ. Constipation and pain are the chief symptoms.

The more severe condition known as mucous colic is characterized by the passage of mucus either in small masses, sheets, or tubular casts. There is a history of obstinate constipation with recurrent attacks of severe abdominal pain, usually on the left side. A considerable quantity of mucus may be passed and the patient will then often enjoy fair health, though with constipation, until the next acute attack occurs.

In a severe attack the abdomen is rigid and very tender; distension may or may not be present; visible peristalsis does not occur; vomiting is usual. As the first and last parts of the colon are especially prone to the spasm, the conditions most likely to be erroneously diagnosed are appendicitis and malignant disease of the colon.

When numerous attacks have occurred over many years, the diagnosis is fairly easy, but in the earlier attacks it is much more difficult, and without doubt the appendix has often been removed in error.

The diagnosis is especially difficult when little or no mucus

has been passed by the bowel, but there are certain features which are very suggestive of this condition. It usually begins in early adult life; it is apt to recur time after time, and may last for many years; the patients are frequently neurotic or neurasthenic. The colon can often be felt in the left iliac fossa as a hard narrow cord. There is little or no fever.

A thorough examination of the rectum should never be omitted, for fear of overlooking carcinoma in that position; similarly the abdomen should be carefully and repeatedly examined for any signs of malignant growth in the colon, as both these conditions have given rise to a diagnosis of mucous colitis. As in the case of intussusception, a prolonged abdominal examination should be made; an annular growth may not be palpable, but when the portion of bowel above the stricture contracts in an effort to force the intestinal contents onwards, a characteristic hardening appears which is very common in organic stricture.

*Treatment.* When a patient is seen in an acute attack in the early stages of this disorder the diagnosis may be impossible, and if very severe it will probably be wise to explore the abdomen. If this is done it will at any rate clear the ground of any anxiety as to the nature of future attacks, for the bowel is usually found contracted and collapsed even under the anæsthetic. If the symptoms have been located in the right iliac fossa the operation will have been undertaken on the supposition that the case was one of appendicitis, and the question will arise as to the removal of the appendix. On the whole, it is probably prudent to do so.

Cases occur, however, in which the severity of the symptoms is not such as to demand immediate operation, and in this connexion it should be remembered that in a case presenting sub-acute symptoms of obstruction the risks of delay are much less than in cases of peritonitis. An enema should be given at once, and if a copious evacuation results the symptoms may speedily abate. If not, small doses of castor oil may be given, one teaspoonful every hour for, say, eight doses; or calomel, gr.  $\frac{1}{2}$ , every hour until the bowels act. Olive oil in 2-oz. doses daily is very valuable, and suppositories of belladonna, gr.  $1\frac{1}{2}$ , are sometimes useful. The abdominal pain may be relieved by hot fomentations. " "

After the acute attack is over, the constipation, which is nearly always of long standing, should be treated by careful attention to diet and exercise. The diet should be one containing a considerable quantity of cellulose residue, such as vegetables,



brown bread, and fruits, in addition to the ordinary food-stuffs. Plenty of butter is advisable, and also olive oil. If the latter cannot be taken pure it may be given in salads.

#### 6. LEAD COLIC

Lead poisoning is not only seen in workers in lead but may also occur from accidental poisoning in ways too numerous to mention. The commonest manifestation is lead colic. It is sudden in onset and is often preceded by constipation.

The pain is nearly always paroxysmal and colicky in type, and the patient may roll about the bed in his endeavours to get relief. The pain may be mainly or entirely unilateral, and is sometimes relieved by pressure. The abdominal muscles are rigid and contracted and the abdomen is frequently retracted. It does not, therefore, simulate peritonitis, in which condition the abdomen is distended and intensely tender to the touch, and in which the patient lies quietly on his back, but it resembles acute obstruction more closely, though vomiting is often absent; constipation, though usual, is not invariable, and between the paroxysms the patient is not so ill.

During an attack the pulse tension is increased and its rate often decreased. The symptoms may be very acute, but the diagnosis is usually fairly easy provided that the case is carefully investigated on the lines laid down in the previous chapter. The nature of the occupation should always be ascertained in any case presenting acute abdominal symptoms; workers in lead are generally fully alive to the nature of the trouble.

Other signs of lead poisoning are often present, such as a blue line on the gums, anæmia, arterio-sclerosis and albuminuria, wrist drop, or more rarely paralysis of the thenar and hypothenar muscles of the hand or of the upper-arm muscles.

*Treatment.* A hypodermic injection of morphia should be given and repeated if necessary. Inhalations of amyl nitrite are sometimes efficacious in relieving the pain. A hot bath is also very useful, and may be followed by hot fomentations. Free venesection has been recommended as giving prompt relief in some cases.

It is most important to secure free action of the bowels. It is well to begin with an enema, and to follow this with daily doses of magnesium sulphate to which potassium iodide (gr. v) may be added.

## 7. BILIARY COLIC

The pain of biliary colic may be due to the mechanical effects produced by the presence of a gall-stone in the cystic duct or in the common bile-duct, or to cholecystitis. The onset is often sudden. Agonizing pain is felt in the right hypochondrium and the epigastrium, and in the back to the right of the region between the eighth and eleventh dorsal vertebræ. It radiates in all directions, and may be felt in the left hypochondrium, the umbilical region, and in the right shoulder. It is paroxysmal in type, of extreme severity, and may disappear suddenly from the stone escaping into the duodenum. The onset is often accompanied by a rigor.

Fever is common, and is probably due to the accompanying cholecystitis. Vomiting is usual. If the stone is in the common duct jaundice speedily appears; but it is probable that this may also develop when the stone is in the cystic duct, from spread of inflammation from the gall-bladder to the ducts.

The liver is often enlarged, though this may be masked by extreme tenderness and muscular rigidity in the right hypochondrium. Similarly it may be very difficult to determine whether enlargement of the gall-bladder is present, such as occurs from cholecystitis and from distension when the stone is impacted in the cystic duct. In cases of chronic jaundice from impaction of a stone in the common duct, the gall-bladder is nearly always contracted.

The duration of an attack of biliary colic is very variable. If the stone is of small size it may be very transient and unaccompanied by jaundice. In other cases the attack lasts for days, with recurring paroxysms of pain and rapid development of jaundice. The passage of the stone into the duodenum causes immediate relief of the symptoms. Should the stone become impacted chronic jaundice results.

*Diagnosis.* A history of previous attacks is helpful, especially if jaundice has accompanied them. The combination of sudden severe pain in the right hypochondrium with rapid development of jaundice is highly characteristic of a gall-stone in the common duct; but jaundice is often absent and the pain not necessarily intense. Jaundice is also absent when the stone is engaged in the cystic duct, but diagnosis is helped by the fact that the gall-bladder is then usually enlarged and may be felt as a tense elastic swelling below the right hypochondrium.

Several other conditions are capable of giving rise to pain in the upper right quadrant of the abdomen :—

(a) *Renal colic.* The pain of renal colic tends to radiate downwards towards the ureter and groin ; there is pain and frequency of micturition, and the urine usually contains blood and albumen or pus. Physical examination may be somewhat deceptive : an enlarged gall-bladder, for example, may rest on the right kidney so as exactly to simulate an enlarged and tender kidney on bimanual examination.

(b) *Gastric and duodenal ulcer.* Pyloric and duodenal ulcers may give rise to paroxysmal attacks of colicky pain almost identical in character with biliary colic. A history of pain after food is very helpful ; in duodenal ulcer it occurs some two hours or so after food. But pain after food is fairly common with gall-stones, as the stomach when contracting pulls on the adhesions so common in cholecystitis, and thereby gives rise to pain. 'Hunger pain' is fairly characteristic of duodenal ulcer ; it is due to the acid stomach contents passing over the surface of the ulcer, and is relieved by the next meal, which causes a closure of the pylorus. Hæmatemesis and melæna exclude gall-stones.

(c) *Appendicitis.* In some cases of appendicitis the pain and tenderness are much higher than usual, owing to the appendix pointing in an upward direction. In some cases of biliary colic with cholecystitis the distended gall-bladder reaches down as low as the iliac fossa, and there is pain, together with muscular rigidity, in the region commonly affected in appendicitis. In typical biliary colic the pain is high up in the right hypochondrium, is of very severe character, and the patient seeks relief by movement. The pain of acute appendicitis, however, is occasionally of very similar character. The development of a mass, the *upper* limit of which may be defined by the hand, excludes a distended gall-bladder ; whereas in cholecystitis the mass comes from above, and its *lower* limit can usually be defined.

(d) *Lead colic.* See p. 280.

(e) *Movable kidney.* Attacks of severe abdominal pain, accompanied by shivering and vomiting, may occur. The diagnosis depends on the presence of a movable kidney, which becomes very tender at the time of these 'crises' ; of pain radiating towards the ureter ; and sometimes of blood in the urine.

*Treatment of biliary colic.* The pain is so severe that a hypodermic injection of morphia is nearly always necessary, and if of extreme severity chloroform may be given to relieve the pain.

until the morphia has taken effect. Opium should not be given by the mouth, firstly, because it takes more time to act, and secondly because, owing to the vomiting, it may be ejected. If the pain persists, a second injection of morphia should be given.

Hot fomentations should be applied over the liver. A linseed and mustard poultice is a very good application.

If the attack persists, if the jaundice does not abate, if the gall-bladder becomes greatly distended, and especially if signs of suppurative cholecystitis occur, surgical intervention becomes necessary (see p. 266).

If the attack subsides in the course of a day or so the general mode of life must be investigated and regulated. If several attacks have occurred the question of operation must be considered.

## CHAPTER XV

### ABDOMINAL AND PELVIC INJURIES

THE importance of early diagnosis and prompt treatment in cases of abdominal injury cannot be overestimated. Hæmorrhage and peritonitis are the two great dangers to be anticipated, and in many cases death from one or both of these causes can only be averted by timely operation.

It is customary to divide abdominal injuries into WOUNDS and CONTUSIONS. The former include stabs, bullet wounds, and injuries sustained from such accidents as falls upon palings; of these injuries three chief varieties can be distinguished, namely, non-penetrating wounds of the abdominal wall, large wounds or lacerations with protrusion of viscera, and small penetrating wounds without superficial evidence of internal injury. The last class differs from abdominal contusions only in two particulars, (1) that there is more indication of the site of the probable visceral injury, and (2) that there is the added danger of peritonitis from infection carried in from the exterior; this class will therefore be considered together with contusions.

#### 1. *Non-penetrating Wounds of the Abdominal Wall*

When the surgeon is confronted with an abdominal wound, the question which demands immediate answer is whether or not the peritoneum has been opened. The history may throw light upon the question, as, for example, if a pointed weapon has been observed to enter to any depth. The general condition of the patient immediately after the accident is of little value, because the recipient of a stab wound which has only damaged the abdominal wall may exhibit marked signs of shock, whilst a case of penetrating wound with visceral damage may show little or none. The *persistence* or *increase* of symptoms of shock whilst under observation is of far greater value than their presence or absence immediately after the accident.

When there is no other guide, an examination of the wound is the only means of solving the problem. But the one examination which is most easy, and which might at once prove the fact of penetration, is the very one to be strictly avoided, namely,

probing. The objections to this method of examination are (1) that a negative result would be of little value, and (2) that a positive result would greatly increase the chances of peritonitis without affording any information regarding injury to viscera. When the nature of the weapon and the appearance of the wound render it probable that penetration has occurred, preparations should be made as for an abdominal exploration, and the wound should be thoroughly cleansed, enlarged, and examined layer by layer until the peritoneum is reached. The presence or absence of penetration can then be readily ascertained by actual inspection. If it has occurred it is essential to ascertain whether any of the viscera have been damaged, and the operation is therefore proceeded with as described below for abdominal injury of undetermined nature.

### *2. Penetrating Wounds with Protrusion of Abdominal Contents*

The diagnosis of these cases is obvious, though it should be borne in mind that the protruded structures may not be the only ones to have suffered damage. The whole question is one of treatment. The first thing to do is to cleanse the surrounding skin with the greatest thoroughness, and also to wash over the protruded viscera with an abundance of hot saline solution. Any herniated omentum may be tied off and cut away. The rest is to be replaced, enlarging the abdominal wound if necessary quite freely, not only to facilitate the replacement, but also to allow of thorough examination of the rest of the abdominal contents. The peritoneal cavity should be washed out with saline solution, after which the wound should be carefully sutured, layer by layer. There is no need to drain. The following is a good illustration of this class of case :—

A girl, 5 years of age, fell from a first-floor window upon the area railings. When admitted to hospital, several coils of small intestine and some omentum were protruding through a lacerated wound in the left side of the abdomen. The case was treated exactly as described above: she exhibited no symptoms whatever after operation, and the wound healed by first intention.

### *3. Contusions and Penetrating Wounds without Protrusion*

Under this heading are included all classes of abdominal injury without external wound, and also, for the convenience of avoiding repetition in diagnosis and treatment, those cases of

penetrating wounds alluded to above. A large number of abdominal injuries are the result of 'buffer accidents', or crushes, as when the body is caught between two buffers, or run over by a heavy vehicle.

Many other kinds of injury can produce serious intra-abdominal lesions. Thus, a heavy man falling from a height upon the feet may sustain a tearing of the mesentery, from the abrupt and violent strain of a loaded intestine dragging upon it; the kidney may be lacerated by striking the loin across a bar in falling; a distended bladder may be ruptured by merely stumbling against the corner of a table; the upper abdominal viscera may be penetrated by fractured ribs.

The extent of the damage is not to be estimated by the presumed severity of the injury. A heavy cart may pass over a child's abdomen without any ill effects, whilst in another case a blow with the fist may cause a most serious intra-abdominal injury.

In making a diagnosis, therefore, neither the kind of violence nor its estimated degree is to be allowed undue weight. Nor is the presence or absence of superficial injury, such as bruising and abrasions, of any moment. As a general rule, it may be said that the more evident the superficial signs of injury the less likely is there to be a severe intra-abdominal lesion, because the abdominal wall, when exercising its natural protective function, will interpose itself with rigid muscles between the injuring force and the abdominal contents, and so will itself suffer more severely than when the blow falls unexpectedly.

Another point to be borne in mind is that serious results may accrue from a slight injury, if there be at the time any pathological condition within the abdomen. Thus a fall from a bicycle in one instance determined the perforation of a gastric ulcer. An enlarged spleen will be ruptured by a slighter injury than a normal one.

The exact diagnosis of the lesion or lesions resulting from an abdominal injury may be quite simple, but is often extremely difficult; indeed, in many cases it is impossible to be at all certain as to the nature of the injury before the abdomen is opened. The important point to decide is whether operation must be undertaken or not, and this, in the majority of cases, presents little difficulty. If there is any doubt whatever as to the advisability of operation, preference should always be given to the active rather than the procrastinating policy, because an exploratory operation carries with it the minimum amount of

risk, whilst a delay of even an hour or two may determine a fatal issue.

The effects of an abdominal injury may be considered under two chief headings :—

(i) Intraperitoneal hæmorrhage.

(ii) Damage to a hollow organ.

(i) *Hæmorrhage.* The general symptoms common to all forms of severe hæmorrhage are described in Chapter III. In the case of hæmorrhage due to abdominal injury the symptoms of shock are superadded. The severity of the symptoms depends upon the amount of blood effused and the rapidity with which the effusion takes place. It may be so rapid as to cause death without the possibility of surgical interference, or it may be so slight that the blood may be absorbed from the peritoneal cavity without any ill effect resulting. All degrees of severity occur between these two extremes. In some instances the blood escapes so slowly that a localized hæmatocele results, which may give rise later to an intra-abdominal abscess : in other cases the hæmorrhage is neither large enough of itself to cause death, nor small enough to become absorbed, nor slow enough to become encysted : such cases are apt in the course of two or three days to develop a diffuse peritonitis, from which the patient will die unless operation is promptly undertaken. The risks of diffuse peritonitis and of intra-abdominal abscess render it imperative to operate without delay upon every case of intraperitoneal hæmorrhage which is of sufficient severity to be capable of diagnosis.

(ii) *Damage to a hollow organ.* If it is advisable to operate upon every diagnosable case of hæmorrhage, still more necessary is it to operate upon every case in which damage to a hollow organ is diagnosed or even suspected. It is true that some slight cases of bruising of bowel or even of actual perforation may recover spontaneously. Adhesions, especially of the omentum, may act as well as the stitches of the surgeon, but such events are to be regarded as curiosities and are not to be reckoned upon. Micro-organisms, particularly the colon bacillus, can pass through the wall of a bruised but unperforated intestine, and the result of an untreated intestinal injury is usually a fatal peritonitis.

#### METHOD OF EXAMINATION

The patient must be laid upon the back in bed, in a good light, with the abdomen fully exposed.

1. *Inspection* will then determine the presence or absence of



superficial injuries, and the degree of mobility on respiration. Sometimes one region of the abdominal wall will be observed to move better than another, a point which may be of great assistance in the localization of the lesion.

2. *Palpation* will reveal the presence or absence of rigidity of the abdominal wall as a whole, or a greater degree of rigidity in one place than another. This may be of considerable assistance in localizing the site of the internal injury. Both lack of mobility and rigidity, however, may be occasioned by fractures of the ribs or pelvis alone, without internal injury; and careful examination of those structures should therefore always be made.

3. *Percussion* is of great value, provided that its fallacies are constantly borne in mind.

*Shifting dullness* in the flanks may indicate the presence of a large effusion of blood, gastro-intestinal contents, or urine; but a bunch of collapsed intestinal coils, such as frequently results from an abdominal contusion, may equally well produce the physical sign of shifting dullness. On the other hand, the presence of a considerable amount of fluid in the abdomen is by no means incompatible with the absence of dullness in the flanks.

The presence or absence of *liver dullness* may be an equally fallacious sign; it requires a considerable amount of free gas in the peritoneal cavity to give definite signs of its presence by obliterating the normal liver dullness, especially if the perforated organ is situated low down in the abdomen and under shelter of the great omentum. On the other hand, a distended colon pushed upwards may give rise to a tympanitic percussion note over the right costal margin anteriorly.

4. The *general condition* of the patient must be carefully estimated. The degree of *shock* is by no means always proportionate to the severity of the injury; it is sometimes profound in a case where the opening of the abdomen would reveal nothing abnormal, whilst it sometimes happens that so serious an injury as laceration of the bowel is accompanied by very little evidence of shock. The *persistence*, and especially any *increase*, of the symptoms of shock are more important than its apparent degree immediately after the accident.

5. *Vomiting*, again, may be present in slight and absent in severe injuries, or vice versa.

It may be said that no one of the above-mentioned symptoms and signs taken alone is of much value in making a diagnosis; they must all be placed together, and the clinical picture presented must be looked at as a whole.

6. The most important and reliable sign, and one which may, on account of its significance, be regarded as standing alone, is the *pulse-rate*. It is not infallible, but it is by far the most reliable guide. It should therefore be taken and recorded at regular, short intervals. At first rapid, it frequently slows down somewhat when the initial shock is passing off; any subsequent acceleration should be regarded as exceedingly serious, and is sometimes sufficient of itself to warrant an exploratory operation. A steadily increasing pulse-rate indicates either progressive hæmorrhage or spreading peritonitis from the rupture of a hollow organ.

The following is a good illustrative case: a boy, 18 years of age, had been shot in the abdomen, close to the umbilicus, with a revolver bullet. He was brought to hospital at once, and presented absolutely no symptom or physical sign of intra-abdominal injury, except that the pulse-rate steadily increased from 90 to 120. The abdomen was opened twenty hours after the injury, operation being determined upon by this one symptom, and there were found two perforations and three bruises in the ileum. These were sutured and he made an uninterrupted recovery.

7. The *examination of the urine* should never be neglected. The presence of blood will point to an injury of the bladder or kidney, but its absence does not exclude the possibility of such an injury, as the kidney may be extensively damaged and the blood prevented from reaching the bladder either by rupture or blocking of the ureter by clot. Hæmaturia, however, does not of itself provide sufficient ground for operating, as many cases of contusion or of slight retroperitoneal laceration of the kidney get well without operation.

#### INDICATIONS FOR IMMEDIATE OPERATION

1. If symptoms of shock persist, the abdomen remains rigid, the pulse increases in rapidity, the lips become blanched, and dullness is noted in the flanks, the case is probably one of intra-peritoneal hæmorrhage, and operation must be undertaken as soon as possible.

2. If the abdomen becomes more rigid, vomiting persists, loss of liver dullness is noted, and, above all, if the pulse-rate progressively increases, the case is probably one of ruptured stomach or intestine, and operation must be performed immediately.

3. If the pain and rigidity are more marked in the lower part of the abdomen, if frequent futile attempts at micturition are made,

and the catheter withdraws only a small amount of bloody urine, and, especially if a fracture of the pelvis is present, operation for probable rupture of the bladder should be undertaken at once. A word of warning is not out of place here. The fact that a large quantity of urine can be readily withdrawn by catheter is not conclusive proof of the integrity of the bladder, because the instrument may pass through a rent in the vesical wall, and withdraw urine, which may or may not be mixed with blood, from the peritoneal cavity.

Having decided to operate, the question may arise whether or not to wait until shock has passed off. It may be said at once that unless the patient is *in extremis*, in which case operation is unlikely to offer any prospect of recovery, the presence of shock should in no way delay the operation. It is quite a common experience to find that the administration of an anæsthetic causes the general condition to improve considerably. If the symptoms are very severe it is wise to perform intravenous saline infusion as soon as the anæsthetic has been commenced.

#### OPERATION FOR ABDOMINAL INJURY

Even if a definite diagnosis has not been arrived at, there will probably be some indication as to the region in which the lesion lies, as has been pointed out previously, in which case the incision should be made through the rectus sheath, splitting the muscle in the direction of its fibres as near to the site of the supposed injury as is practicable. If there is no such guide, the incision should be made to one side or the other of the umbilicus; it can readily be extended upwards or downwards when the lesion is discovered. Much, as a rule, depends upon completing the operation as rapidly as possible, for which purpose it must be remembered that a small and timid opening increases the difficulty of exploration, hampers manipulation, and wastes valuable time.

##### (i) TRAUMATIC HÆMORRHAGE

On opening the abdomen it will at once be evident whether there is diffuse intraperitoneal hæmorrhage or not. Should free blood be found, a systematic search must be made for the bleeding-point. This may be apparent at once, but there are many cases in which the task is one of great difficulty. Hæmorrhage from a piece of torn mesentery or omentum may have ceased and the actual bleeding-point may be undiscoverable. The fact that

there may be more than one source of hæmorrhage, and more than a single viscus injured, should never be overlooked. In the hurry of a critical operation of emergency it is easy to forget that the particular lesion first found may not be the only one present. The following are the situations from which traumatic hæmorrhage commonly occurs :—

(a) *Rupture of the liver.* Almost any degree of laceration may be met with, from single small rents up to the most extensive tearing and the separation of fragments which may be found free in the peritoneal cavity. The more serious cases are almost always accompanied by other injuries and are commonly fatal. But quite large lacerations may be recovered from if treated promptly, and if unaccompanied by serious damage elsewhere. It is rarely any use attempting to suture rents in the liver, as the stitches readily tear out of the soft liver tissue. Any specially prominent bleeding-point can be secured by passing a thick cat-gut suture with a blunt needle (a small probe makes an excellent instrument for this purpose) so as to include the vessel in a mass of liver substance, and tying it firmly but not too tightly. The rents are best packed tightly with broad strips of sterile gauze, the free ends of which are to be left protruding from the abdominal wound, and gradually removed after a few days.

(b) *Rupture of the spleen.* Similar remarks apply to this viscus as to the liver. The splenic tissue is so friable that sutures will rarely hold, so that the choice lies between plugging the rents and splenectomy. Different opinions are held upon the question of removal of a lacerated spleen, and the operation is so easy that the temptation to excise the injured organ is considerable. Obviously there are some cases of total disorganization, in which removal is the only possible plan, but there are other cases in which, even when extensively torn, the spleen may be saved by carefully plugging the rents with gauze, and leaving the free ends of the plugs out of the abdominal wound, to be gradually removed after a few days. That a patient can survive without a spleen has been amply proved, but how far recovery may become complete, and how far survival depends upon the accidental presence of accessory spleniculi, is not so clear. There is no justification for removing a spleen which could possibly be saved by some such means as that suggested.

(c) *Rupture of the kidney.* This may be intraperitoneal or retroperitoneal. In the former case, and with extensive laceration, the same problem as in the case of the spleen will present itself, namely, whether or not to remove the damaged organ.

Unlike the spleen, the kidney is of firm consistence, and, having a tough fibrous investment, can be sutured, and wounds of the kidney heal well. The kidney should never be removed merely as an easy method of arresting the hæmorrhage, and, if the main vessels are not torn, an attempt, by suturing and plugging, should be made to save the organ. In this case the free ends of the plugs are to be brought out through a separate incision in the loin, where they serve also the purpose of allowing for the escape of urine.

If the rupture is retroperitoneal, there will be a lumbar swelling instead of the signs of free fluid in the peritoneal cavity. This, when not very large or increasing, and when the general symptoms of hæmorrhage are not severe, may be left alone, as the blood may perhaps be absorbed. It is very likely, however, to give rise to a peri-renal abscess, so that severe cases are best treated by lumbar incision, turning out the clot and blood and, after plugging the lacerated kidney, draining the wound. For this purpose the patient must be placed upon the opposite side, with a sand-bag beneath the loin. The incision extends from the angle formed by the edge of the erector spinæ and the last rib, downwards and forwards for about five inches. The abdominal wall is cut through in the line of this incision until the peri-renal hæmatoma is reached.

(d) *Traumatic hæmorrhage from other sources.* If no laceration has been found in the situations indicated, a careful search must be made over the omentum and mesentery. Sometimes a bruised area, or adherent clot, will serve as a guide to the torn vessel. When the bleeding, from whatever source, has been arrested, the peritoneal cavity should be washed free of blood and clot by a copious stream of normal saline solution at a temperature of 105° F. This may be done by means of a sterilized tube connected with an irrigator, but if the apparatus is not at hand the fluid may be poured directly into the abdomen from a large jug. As much fluid as possible may with advantage be left behind, as its absorption will tend to replace the blood lost. The abdomen should be closed without drainage, except in so far as it is necessary to leave the ends of the gauze plugs projecting, in the circumstances indicated above.

## (ii) INJURY TO THE HOLLOW VISCERA

Rupture of one of the hollow viscera may be present in addition to diffuse intraperitoneal hæmorrhage. This may have been suspected from the symptoms before operation, or may be

indicated when the abdomen is opened by the presence of gastric or intestinal contents, free gas, urine, or bile. In such circumstances the viscera must be examined systematically, beginning with the stomach (of which the posterior wall as well as the anterior is to be investigated) and following the intestines down coil by coil. Examination of the gall-bladder should not be neglected. A rupture of the urinary bladder will be indicated by the presence of clear fluid in the peritoneal cavity.

(a) *Rupture of the stomach.* Apart from bullet wounds, rupture of the normal stomach is an accident of great rarity. On the other hand, in a large number of the cases of 'perforated gastric ulcer' the final phase is traumatic and not ulcerative, and is due to the tearing away of a chronic ulcer from the liver or other organ to which it had been adherent, or else to the tearing of the thinned floor of an ulcer. In the subject of a chronic gastric ulcer, any sudden exertion, especially when following a heavy meal, may bring about the rupture; in one case the immediate cause was a fall from a bicycle in a patient in whom the previous existence of a gastric ulcer had been unsuspected. The treatment of this class of rupture of the stomach is discussed in Chapter XIII.

Should a perforation of the stomach from a bullet wound or other injury be found, the treatment will be the same as that of pathological perforation, namely, closure of the opening by a double row of sutures, and lavage of the peritoneal cavity (see p. 252).

(b) *Rupture of the gall-bladder and bile-ducts.* Bullet wounds and stabs of these parts have been recorded, and, if met with, should be treated by suture if possible, and if this is not practicable, by packing and drainage, together with cleansing of the peritoneal cavity. Rupture without external wound is extremely rare, nevertheless 24 cases have been collected by Desrosiers, 9 of which involved the gall-bladder, 2 the bile-ducts, and in 13 the exact site of injury to the biliary passages is not recorded. The treatment would be the same as for the penetrating injuries.

(c) *Rupture of the intestines.* The intestines may be ruptured by either penetrating or non-penetrating injuries. The treatment will be the same in either case.

The damage may only amount to bruising or partial laceration without opening into the lumen, or it may involve actual rupture with extravasation of contents. A series of 132 of the latter class have been recently collected by Berry and Giuseppi with the following interesting results. In 16.6 per cent more than one

rupture was present ; the small intestine alone was ruptured in 87 per cent ; the colon alone in only 7·5 per cent ; and the large and small gut together in 3 per cent. In this series there were but 17 recoveries (mortality of 90 per cent).

The prognosis chiefly depends upon the time that has elapsed between injury and operation. Every hour that is wasted makes the chance of recovery less.



FIG. 65. Suture of wounded intestine. First stage.  
(The prolapsed mucous membrane is not shown.)

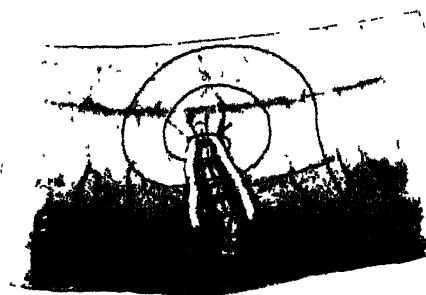


FIG. 66. Suture of wounded intestine. Second stage.

*Treatment.* If the tear has not opened into the intestinal lumen all that is necessary is to sequestrate the site of injury by a row of peritoneal sutures and to close the abdomen. When the rupture has opened the lumen of the bowel the rent must be closed with a double row of sutures, the first including all the coats and the second the peritoneum only. The line of suturing should, by choice, lie in the transverse axis of the bowel so as not to constrict the lumen (Figs. 65 and 66). When the gut has been torn completely across, the edges of the tear should be trimmed or excised and a circular anastomosis performed (Figs. 67-70).



Fig. 68. Second stage.



Fig. 70. Fourth stage.



Fig. 67. First stage.

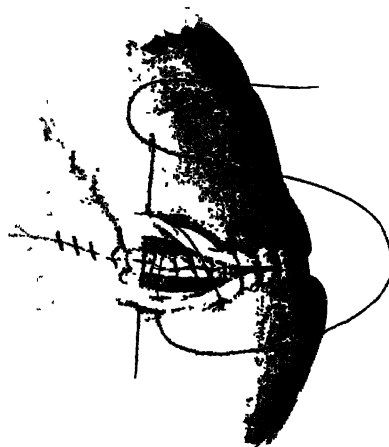


Fig. 69. Third stage.

END-TO-END ANASTOMOSIS.



A careful search should be made for other lacerations before the abdomen is closed, because multiplicity is not very uncommon (16.6 per cent).

After dealing with the damaged intestine, the abdomen should be thoroughly flushed out with saline solution and closed. Drainage is not necessary in all cases, particularly in those operated upon early, and these are the only ones which have any reasonable chance of recovery. If there has been much faecal extravasation it is wiser to leave a drainage tube through the abdominal wall into the pelvis.

(d) *Rupture of the urinary bladder.* A great deal has been written about the differences between intraperitoneal and extra-peritoneal rupture of the bladder, but in healthy persons the distinction is of little practical value, especially as the rent is not infrequently found to implicate both peritoneal and non-peritoneal aspects. Provided that the urine is healthy and operation is promptly carried out, the risk of peritonitis is slight. But in those rare cases in which the wall of a diseased bladder gives way from slight violence, the outlook is extremely grave. It is in such cases as these, the urine being highly septic, that the prognosis with an intraperitoneal is worse than with an extra-peritoneal rupture.

The symptoms of rupture of the bladder are, as a rule, sufficiently clear for a definite diagnosis to be arrived at; shock is usually severe, and a fracture of the pelvis will increase the likelihood of there being a rupture of the bladder or a laceration of the urethra behind the anterior layer of the triangular ligament. There may be shifting dullness in the flanks. The patient desires to pass water frequently, but is unable to do so; he may from time to time void a little bloody urine. On passing a catheter nothing may be withdrawn except perhaps a small quantity of blood-stained urine. On the other hand, the result may appear to be normal, for the catheter may pass through the rent and tap the urine that had escaped into the peritoneal cavity. The injection of fluid into the bladder as a means of diagnosis is both useless and mischievous. If there is any doubt at all whether the bladder is ruptured or not, exploration should at once be proceeded with.

*Operation.* A median incision, immediately above the pubic symphysis, passes between the two rectus muscles and exposes the subperitoneal tissue. The reflection of the peritoneum from the bladder on to the abdominal wall is then identified and retracted upwards. The bladder is opened and explored with the finger. If

the rent is found to involve only the peritoneal aspect of the bladder, the incision is continued upwards in order to open the peritoneal cavity. The rent is then closed with two rows of continuous suture. The first, of catgut, includes all the coats; the second, of fine silk, involves peritoneum only. The peritoneal cavity is next flushed out with sterile saline solution and closed. A drainage tube is left in the bladder for a few days.

Should the rent be found to be entirely extra-peritoneal it should be sutured with catgut and the bladder drained as described above. In this case the peritoneum will not be opened. Sometimes the tear involves both peritoneal and non-peritoneal aspects. In this case the operation must be as for intraperitoneal rupture.

*After-treatment of cases operated upon for abdominal injury*

The methods of treating *shock* are discussed in Chapter I.

*Morphia* is best withheld altogether, on account of its liability to cause constipation, and to inhibit peritoneal phagocytosis, upon which depends the patient's chance of resisting a fatal peritonitis. If restlessness is a marked feature, which as a rule is not the case, other sedatives should be tried before resorting to morphia.

The *posture* is important. In cases of hæmorrhage the head of the bed should be lowered and the patient kept quite flat without a pillow. But in peritonitis the position should be exactly reversed, the patient being propped up almost into a sitting position.

Abdominal *distension* is common after abdominal injury, and should be relieved by enemata containing turpentine (an ounce to half a pint of soap and water). In bad cases oil of rue given in an enema is a most valuable drug (see p. 103).

*Vomiting* should be treated by gastric lavage if small doses of cocaine or of tincture of iodine fail to relieve it.

In many cases an *aperient* should be given early, and the best is undoubtedly castor oil. If this is not tolerated on account of vomiting, calomel should be used instead. But when the intestine has been lacerated it is best to depend solely upon enemata. With regard to food, nothing but water will be required for the first twenty-four hours, after which diluted milk may be begun, in small quantities given frequently. If all goes well, the milk may soon be given undiluted and in larger quantities, and food gradually increased. If the temperature rises, a close watch should be kept for the possible formation of localized intraperitoneal abscess.

## PELVIC AND PERINEAL INJURIES

*Rupture of the Urethra*

This injury may occur alone, as from falls and kicks upon the perineum, or in association with fracture of the pelvis. Any degree of laceration may be present, from a slight tear to complete disruption with wide separation of the ends. Great difficulty may be experienced, in what appear to be the slighter cases, in determining whether operation should at once be proceeded with or not, but it may be laid down that, as a general rule, there is a great deal more risk in temporizing than in operating.

The *symptoms* of ruptured urethra are intense pain, accompanied by frequent fruitless efforts to micturate. There may be merely the escape of a few drops of blood from the meatus, but occasionally the hæmorrhage is very brisk, the blood actually spurting from the meatus in jets as if from an artery. Frequently there are some local signs, such as tenderness, ecchymosis, or definite urinary extravasation in the perineum. On introducing a catheter it may be found that the instrument is arrested and cannot with gentle manipulation be made to pass the site of injury. In this case operation must be proceeded with at once.

If, however, the catheter does pass easily into the bladder, and there is no extravasation, it may be left there in the hope that the urethra will heal over it without further trouble. But if this expectant plan is adopted a very close watch must be kept for signs of extravasation. The objection to this method is that the laceration may be severe, though incomplete, and that the catheter may have slipped in by good luck. In such a case the amount of cicatricial tissue will be considerable and the resulting stricture may prove intractable.

*Operation.* The patient is placed in the 'lithotomy position', with the pubes, scrotum, and perineum shaved and cleansed. The site of the laceration having been determined by a sound in the urethra, an incision is made over it in the mid-line, and is deepened until the urethra is reached. The presence of blood-clot infiltrating the tissues will probably cause some difficulty at first, but as it is removed it may be found to be of actual assistance by having, as it were, dissected out the urethra in the region of the laceration (Fig. 71). The urethra must now be sutured, and the best material for the purpose is catgut. The urethral roof is rarely torn, but if this should be the case, the first stitches must be passed from inside the urethra, and made to close the rent in its roof.

Sometimes, when the urethra has been torn completely across,

the vesical end cannot be found even after the most careful and diligent search. In such a case there should be no hesitation in opening the bladder above the symphysis and passing a catheter down the urethra from inside the bladder. The wound in the bladder may afterwards be sutured completely, the superficial incision being drained for a few days in case of leakage.

A large gum-elastic catheter should next be passed from the meatus into the bladder, and the suturing of the urethra completed over it, first on the lateral, and finally on the inferior aspect. No sutures are to be placed in the perineal wound,

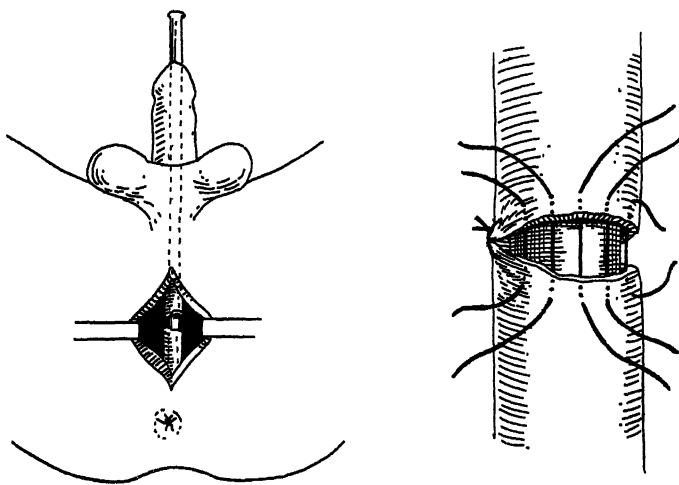


FIG. 71. Suture of lacerated urethra.

which should be packed with gauze. If extravasation has already occurred, free incisions into the infiltrated tissues will be required in addition.

*After-treatment.* The catheter should remain *in situ* for ten days unless any untoward symptoms demand its earlier removal. It is well to let the patient sit in a bath for half an hour daily until the wound is healed. Subsequently a large-sized sound should be passed at regular intervals in order to prevent the formation of a stricture.

#### INJURIES AND ACUTE AFFECTIONS OF THE RECTUM

(a) *Wounds.* The rectum may be wounded either by fragments of bone in fracture of the pelvis, by the introduction of an enema tube, by falls upon sharp objects, such as railings, or during

## (b) INJURY TO A HERNIA

A patient with a hernia occasionally receives a blow upon it, or it is bruised by a fall upon the truss pad. The accident is most likely to happen to an irreducible hernia, or one which is inefficiently controlled by a truss. It is likely to be followed by inflammation, which, if the bowel has been sufficiently bruised to permit of the egress of micro-organisms, may even result in a localized suppurative peritonitis in the sac.

The treatment consists of rest in bed, with the local application of an ice-bag or hot fomentations, the case being most carefully watched in order that, should necessity arise, operative interference may be carried out at the proper moment. Should suppuration in the sac take place it must be treated exactly on the lines of a localized intraperitoneal abscess.

An *inflamed hernia* is not a condition of very frequent occurrence. It may be extremely difficult to diagnose from a strangulated hernia, and when in doubt it is wiser to treat the case as one of strangulation rather than allow the patient to incur the risks which attend delay.

## (c) STRANGULATED HERNIA

The strangulation of a hernia usually occurs during some act of straining, and the symptoms may come on either abruptly with sudden local pain and faintness, or more gradually. There is generally a history of pre-existent hernia, but sometimes either the patient has been unaware of having had a hernia, or the act of straining may have extruded a loop of gut through the narrow neck of a congenital sac which had never before been occupied by a hernia. This latter class of hernia is the one most likely to be attended with gangrene, because of the tightness of the constriction.

*Diagnosis.* The chief symptoms are those of intestinal obstruction. There are, in addition, the local signs of irreducibility, pain, tenderness, and absence of impulse on coughing. In the case of an old hernia the swelling will be found to be larger and more tense than usual.

With regard to impulse on coughing a word of warning may be given. Too much importance is apt to be attached to this most fallacious sign. On the one hand it requires great delicacy of touch to be able to distinguish between the impulse in a hernia and the sensation communicated to it as a whole by the sudden upheaval

of the abdominal wall, especially in a fat subject ; on the other hand a genuine impulse may be present in a hernia strangulated at some point other than the internal abdominal ring. The following is an instance in point : a patient with a tender, somewhat tense scrotal hernia was admitted to hospital with symptoms of intestinal obstruction of a mild order, but as there was a good impulse in the hernia, operation was delayed for some hours. The symptoms, persisting, however, the sac was explored, when a coil of small intestine was found ensnared and obstructed beneath a band which traversed the sac. The delay proved fatal.

The actual obstructive symptoms may be anomalous. Thus, it is not uncommon for a motion to be passed subsequently to the onset of the symptoms, owing to the evacuation of the bowel contents below the point of obstruction. Moreover, flatus, or even fæces, may be passed if the strangulation concerns omentum only ; or if only a portion of the intestinal wall is nipped (Richter's hernia) ; or, again, if the appendix or a Meckel's diverticulum alone should be strangulated. In a neglected case, or one that has been subjected to violent taxis, the onset of gangrene can sometimes be detected before operation by the cessation of pain and the disappearance of tenseness, the swelling becoming doughy and perhaps giving the sensation of gas-crepitation. There may also be a dusky redness and œdema of the skin.

#### CONDITIONS SIMULATING STRANGULATED HERNIA

(a) *Intestinal obstruction from some other cause in a patient with an irreducible hernia.* The following case illustrates this : a woman aged 42 was admitted to hospital with a history of acute intestinal obstruction of six hours' duration. In the left femoral region there was a tense swelling, devoid of impulse. The case was considered to be one of strangulated femoral hernia, but operation revealed only a hydrocele of a femoral hernial sac. When the abdomen was opened a volvulus of the small intestine was discovered.

On the other hand care must be taken lest the mistake be made of overlooking a strangulated hernia in a patient whose symptoms point only to intestinal obstruction. A small femoral hernia in a fat patient may easily escape notice unless a very careful examination is made, and the abdomen may be opened unnecessarily.

(b) *Irreducible hernia, inflamed or incarcerated, but not strangulated.* These conditions most often occur with umbilical or

large inguinal herniæ containing colon. The swelling is larger than usual, tender, and perhaps tense, and retains its impulse on coughing. But the constitutional symptoms are not serious; there is constipation which can be relieved by enema; nausea, but not vomiting; and no symptoms of collapse manifest themselves. It may be extremely difficult to differentiate such a case from one of strangulation, and if there is the least doubt, operation should be performed without delay.

(c) *Torsion of an imperfectly descended testis.* Such an accident may occur after a sudden strain, and be accompanied by vomiting and collapse, together with the presence of a tender irreducible swelling in the inguinal canal, so as to simulate very closely a strangulated hernia. The diagnosis can sometimes be made only by the operation which is necessary in both cases.

(d) *Acute hydrocele*, either encysted or funicular, may be mistaken for a strangulated hernia, but the absence of obstructive symptoms and the possibility of getting the fingers above the swelling should enable a correct diagnosis to be made. If there should be any doubt, operation must be performed.

(e) *Inflamed glands in the groin*, and even abscess of the labium majus, have been mistaken for strangulated hernia. A careful local examination, together with the absence of symptoms of intestinal obstruction, should readily differentiate the two conditions.

#### TREATMENT OF STRANGULATED HERNIA

*The question of taxis.* Is it or is it not proper treatment to attempt to reduce a strangulated hernia by taxis before proceeding to operation? A good deal must depend upon the circumstances of the individual case. In infants it will frequently prove successful, and an old-standing, large inguinal hernia, previously reducible, will sometimes prove amenable, especially under an anæsthetic. But in a tightly nipped, recent hernia, especially of the congenital variety mentioned above, it is almost certain that taxis will not only be unsuccessful but will also do harm. Again, strangulated femoral herniæ can far less often be reduced than inguinal, whilst umbilical herniæ rarely yield to this manipulation. Attempts to reduce a strangulated piece of intestine may cause so much damage as to determine the onset of gangrene, a risk which must not be lightly undertaken. The probability of failure, combined with the practical certainty of doing serious damage to the bowel, justifies the general rule that taxis is only to be used on the rarest occasions, and then only when the means

of operation are not at hand, or the patient is, on account of age, disease, or other circumstances, unsuitable even for an operation of urgency. Modern methods of local anæsthesia have still further reduced the number of cases in which it is justifiable to employ taxis. In the great majority of cases no attempt at reduction by taxis must be made.

As a general rule, unless the patient is very old or in a state of collapse, a hot bath should be given whilst preparations for operation are being made. It does occasionally happen that after a hot bath a hernia which is only very feebly nipped will become reduced spontaneously, but the chief object of the bath is one of cleanliness as a preparation for operation. Again, when the muscles are relaxed under chloroform a feebly-strangulated hernia will sometimes be found to slip back merely with the manipulation incidental to shaving and washing.

#### OPERATION

The incision for a strangulated *inguinal* hernia should be in the long axis of the tumour, and should reach from the pubic crest nearly to the level of the anterior superior iliac spine. A long skin incision has no drawbacks and materially assists the operation.

In *femoral* hernia the incision may be vertical, extending from just above Poupart's ligament downwards for about three inches, just internal to the femoral vessels. A better method is to raise a flap of skin and fascia, with its convexity outwards, from over the swelling. This allows the femoral canal to be exposed before the sac is opened, and also places the incision as far as possible away from the septic region of the genitalia.

In *umbilical* hernia a crescentic incision should be made to one side or other of the tumour, so as to identify the umbilical ring before the sac is opened. The skin and sac over the front of such a hernia are usually so closely adherent to one another that an incision in this situation would at once open the sac, whilst towards the side of the hernia some fatty connective tissue intervenes, so that the two structures can easily be separated.

In all varieties, after opening the sac, the constriction must be identified and divided. The direction of the incision should be upwards in inguinal, inwards in femoral, and at the most convenient spot in umbilical hernia. It is best to make two or three small incisions at different spots, rather than one deep cut. If this is done the risk of wounding an aberrant obturator artery



in femoral hernia, or the deep epigastric artery in inguinal hernia, is practically abolished. A hernia director is quite unnecessary; it is sufficient to hold back the bulging contents with the left forefinger whilst the hernia knife is passed and the constriction divided.

The hernial contents should now be pulled down, so that a thorough view may be obtained of the site of the constriction

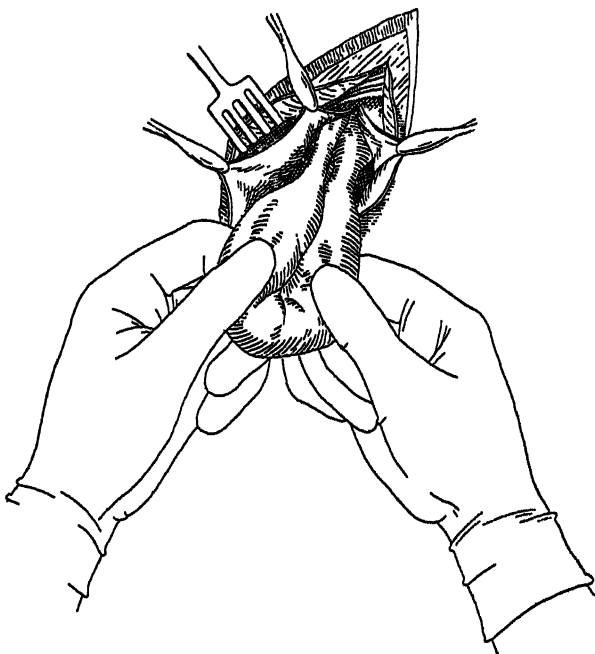


FIG. 72. Examination of the bowel in a strangulated inguinal hernia. The strangulated loop has been drawn down after division of the internal ring. The 'constriction rings' are well shown.

as well as of the whole of the contents (Fig. 72). If omentum is involved it may at once be tied off and cut away, several small portions being ligatured separately rather than one thick bunch. The ligatures should be tied very tightly, and the omentum cut through not too near them, to prevent the possibility of their slipping, a serious accident which might result in the escape of a very large quantity of blood into the peritoneal cavity and necessitate another operation.

*The condition of the bowel should be very carefully inspected*

both before and after the constriction has been divided. More will be learnt by waiting a few moments than is possible directly the sac is opened, as considerable improvement in appearance may take place with the restoration of the circulation. Unfortunately it is impossible to lay down any definite rules for the guidance of the operator in forming an opinion either as to the state of the bowel or the treatment to be adopted; even experience, the safest guide, will sometimes be found to be at fault.

The *colour*, if uniform, is perhaps the least reliable test of all, because a coil which is almost coal-black will sometimes recover when one which is only slightly congested will become gangrenous.

A *mottled appearance* is a bad sign, particularly if any of the patches have a greyish look, because this implies deep ulceration of the mucosa and the risk of perforation at those spots should the bowel be returned into the abdomen. Similarly, well-marked rings at the site of constriction signify deep ulceration of the inner coats. Not only are such constriction rings possible sites of perforation, but they render the intestine peculiarly liable to become kinked, a condition which may cause fatal obstruction, or assist in bringing about a perforation. They may also cause obstruction from cicatricial stricture at a later period (see p. 250).

The degree of *smoothness* of the peritoneum, and the presence or absence of flakes of fibrin upon it are useful as indications of a localized peritonitis, but are not to be taken as evidence of non-viability of the bowel.

The *condition of the circulation* in the gut can readily be ascertained by gently squeezing it and observing whether the colour returns rapidly on removal of the pressure.

The *degree of elasticity* is highly important. A piece of bowel which has lost its natural resilience, and has become soft and inelastic to the touch, has little chance of recovery.

#### *Treatment of the Intestine in a Strangulated Hernia*

This may conveniently be described under the following headings:—

1. When the bowel is certainly viable.
2. When the viability of the bowel is in doubt.
3. When actual gangrene is present, or seems inevitable.

1. *When the bowel is certainly viable.* In this case the gut

should be washed over with sterilized saline solution and returned into the abdomen. If the general condition of the patient is good, as is probably the case, a radical cure should be effected at the same time.

2. *When the viability of the bowel is in doubt.* The coil should be washed over and returned into the abdomen, and a gauze drain should be inserted down to it through the hernial orifice. A radical cure can be performed later. The coil of bowel does not tend to move away from the position in which it is placed, namely close to the hernial orifice, so that if perforation should occur the bowel will by that time have become shut off from the peritoneal cavity by adhesions, and the intestinal contents will escape along the track of the gauze drain. The faecal fistula which results will probably close spontaneously. If it does not, it can be dealt with by a subsequent operation.

3. *When actual gangrene is present, or seems inevitable.* The age and general condition of the patient, as well as the state of the intestine, are to be taken into account in deciding upon the course to be pursued. In young children resection is almost certain to prove fatal, so that any other procedure which offers a prospect of success without resection is to be preferred; in the aged, or those in very bad condition, the proper course is to do as little as possible, in the hope that the patient may recover sufficiently to allow of something more radical being attempted. Two varieties of gangrene or threatened perforation may be disposed of at once; they are cases in which there are small patches of necrosis, or very well-marked 'constriction rings' or lines of necrosis at the site of strangulation, the rest of the strangulated coil being recoverable. In these cases the areas in question may be sequestered or invaginated by means of a few Lembert's sutures, in just the same way as the stump of an appendix is invaginated into the wall of the caecum. The line of suturing should pass as far as possible at right angles to the long axis of the bowel, so as not to diminish the width of its lumen. When the sequestration of any doubtful patches has been carried out the operation should be completed as in case 2 above.

When the whole loop or the major part of it is gangrenous, four courses are open:—

(a) To resect, perform immediate anastomosis, and complete the operation by a radical cure. The cases in which this line of treatment is possible must obviously be few, for by the time gangrene has occurred the patient is probably too ill to stand such a prolonged operation. A suitable case would be afforded

by a patient, young, healthy and in good general condition, in whom the strangulation had been present only a short time. The herniæ which most rapidly become gangrenous are those which appear suddenly and become strangulated at once, such as the congenital ones, as in these cases the constriction is usually extremely tight.

(b) To resect, perform anastomosis, and leave a drain down to the anastomosis, performing the radical cure at a later stage.

(c) To resect, and establish a fæcal fistula by tying a Paul's tube into each end of the divided intestine. There is one grave objection to this method of procedure. It is impossible to be certain what part of the small intestine is involved, and if it should happen to be high up in the jejunum the patient will rapidly suffer from malnutrition, whilst the skin will become digested and render further operation both difficult and dangerous. Unless, therefore, the patient is very bad it is better to perform a rapid circular anastomosis, which should not add more than five minutes to the time of operation, and proceed as in (b).

(d) To pack gauze around the gangrenous coil, so as to shut it off from the general peritoneal cavity, and then to cut away the greater part of it so as to establish a fæcal fistula which may be dealt with at a later stage. This is an elementary procedure which is only applicable to cases in which the patient is *in extremis*; it should be done under local anæsthesia.

### *Resection of Gangrenous Intestine*

When gangrene has occurred, the patient's general condition is usually such as to make the most rapid operation the one of choice. Lateral anastomosis, although perhaps somewhat safer, takes rather more time than end-to-end anastomosis, and the latter is generally to be preferred.

(a) *The resection.* Although the whole intestine above the obstruction will be distended with fæcal fluid rich in virulent micro-organisms, and it would be difficult to find any spot at which the gut could be called healthy, yet experience has shown that the further away from the gangrenous coil the section is made, the more likely is the result to be satisfactory, despite the fact that the greater the amount of intestine removed, the greater will be the shock. As a general rule, not less than twelve inches of bowel above the obstruction should be removed; at the distal end the section of gut may be made much nearer to the gangrenous bowel.

The site of the section having been decided upon, an intestinal

clamp is to be applied a few inches beyond the spot. A special clamp is convenient but is not necessary, and in case of emergency a piece of fine rubber tubing or even a piece of stout silk may be passed through a small hole in the mesentery and tied gently round the bowel. The operative field is next packed off carefully with gauze, and the bowel cut across with scissors. A certain amount of soiling by intestinal contents may be saved by ligaturing the piece of bowel to be removed close to each point of section. The mesentery is to be tied off in sections with fairly stout silk and cut through bit by bit.

(b) *The anastomosis* (see p. 295). The best method is the simplest, namely, that of end-to-end suturing without mechanical appliances. The best needle is a large-sized common sewing-needle. The first stitch is a single one, and is to be passed through the mesentery of both ends, as close to the bowel-wall as possible, in such a manner as to obliterate the small triangular area of intestinal wall at the mesenteric attachment which is uncovered by peritoneum (Fig. 67). Next, a long silk thread is run round the cut edges, passing through the whole thickness of the bowel-wall (Fig. 68) in such a manner as to approximate the edges all the way round. With a little care the difficulty caused by the distended proximal end being larger than the distal collapsed end can be overcome. Care must be taken not to draw the suture so tightly as to produce narrowing of the lumen. A second continuous suture is then passed, taking up peritoneum and muscular coats only, so as to bury the first line of junction completely (Fig. 69). The anastomosis is now complete (Fig. 70), and the gut, having been washed over with saline, is to be gently returned within the abdomen. If there is any fear of leakage a gauze drain may be left in, passing through the hernial orifice down to the anastomosis, and the radical cure may be completed at a second operation.

In the hands of those accustomed to its use, the Murphy button possibly affords a rather more rapid method of end-to-end anastomosis. A purse-string suture is run round the mouth of each intestinal segment close to its edge, and including its whole thickness. Into each end one-half of the button is introduced, and, whilst it is held in place with a pair of forceps, the purse-string suture is drawn tightly around it and tied. The anastomosis is completed by pressing together the two halves of the button. The chief objection to this method is that the hernial orifice may have to be enlarged considerably to allow of the button passing through it.

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*After-treatment.* For the first twenty-four hours the patient will require nothing by the mouth except small quantities of water. After that time fluid nourishment may be given, in small quantities at a time, and gradually increased. If all goes well, the bowels will act naturally and there is no need to give an aperient. Occasionally enteritis, caused by the damage to the bowel, causes diarrhoea for two or three days after the operation, but this is of little moment unless excessive and persistent, when opium may have to be given by the mouth. If a drain has been left down to the anastomosis and leakage takes place, the fæcal fistula which results will usually close spontaneously.

In cases where suture or anastomosis of bowel has been necessary, the special treatment required will be precisely the same as after operations for intestinal obstruction from other causes. (See Chapter XIII.)

## CHAPTER XVII

### ACUTE AFFECTIONS OF THE GENITO-URINARY SYSTEM

#### I. RETENTION OF URINE

RETENTION of urine may be *obstructive* or *non-obstructive*. The chief *obstructive* causes are acute inflammatory conditions in and around the urethra, such as acute gonorrhœa and peri-urethral abscess; stricture of the urethra; prostatic enlargement; injury of the urethra; impaction of a stone or other foreign body in the urethra; and occasionally stone or tumour of the bladder, causing a mechanical obstruction at its neck.

In women, the comparatively rare event of obstructive retention is most often brought about by displacement of the gravid uterus, and may readily be relieved by manipulation of the organ; it is occasionally due to the impaction of pelvic tumours.

The *non-obstructive* causes are nervous in origin and may be occasioned by gross disease or injury of the spinal cord; by functional disease; or by reflex nervous conditions, as after operations for hæmorrhoids and the like.

After the relief of obstructive retention it is not uncommon for the patient to be unable to void urine naturally for a day or two, or even longer, this disability being due to atony of the bladder, the result of the over-distension. This condition of atony is best treated by strychnine.

*Diagnosis.* The degree of distension of the bladder is first to be noted. Occasionally a patient with a distended bladder will complain of being unable to hold his urine, the condition being that of distension with overflow. Palpation and percussion will readily reveal whether the bladder is full. The history will point to the probable cause, and the passing of a urethral sound, and the examination of the prostate *per rectum* will enable a correct diagnosis to be made. The treatment of retention will be dealt with under the following headings :—

*(a) Acute Urethritis*

Retention occurring during the course of acute gonorrhœa is due partly to the swollen condition of the mucous membrane and partly to superadded muscular spasm, so that relief can generally be obtained if the spasm can be overcome. The passage of a catheter is strictly to be avoided, because not only is such a procedure intensely painful, but it is almost certain to be followed by extension of the infection to the deep urethra, bladder, prostate, or epididymis.

*Treatment.* A dose of morphia should be given, and the patient made to sit in a hot hip-bath and encouraged to pass water in the bath. This will usually be found efficacious, and a repetition of the retention will be avoided by keeping him in bed and giving saline aperients and a light diet.

Another simple procedure which sometimes gives relief in these cases is the administration of a hot soap and water enema. If these measures should fail, there still remains an alternative to the passage of a catheter, namely, suprapubic puncture. This little operation is practically devoid of danger if properly and aseptically carried out, and is much to be preferred to the risks entailed by the passage of a catheter. The relief of congestion and spasm which suprapubic puncture affords will enable the patient to void his urine naturally afterwards. The after-treatment is the same as if relief had been obtained by the hot bath.

*Operation of suprapubic puncture.* The pubes having been shaved and thoroughly cleansed, a sterilized trocar and cannula of small size should be thrust into the bladder, keeping exactly in the mid-line and as closely to the bone as possible; in fact the instrument should actually touch the symphysis. There is no need to use an aspirator, as the urine, being under great pressure, escapes readily as soon as the trocar is withdrawn. When the urine has ceased to run, the cannula is to be withdrawn and the little wound sealed with collodion. The risk of extravasation into the prevesical space is very slight, provided that the trocar is of small size, because the mucous membrane and muscle of the bladder-wall immediately close the tiny puncture. Moreover, in the class of case under consideration, the urine is presumably aseptic, so that the cellular tissue will not be infected during the withdrawal of the cannula.



*(b) Stricture*

Retention due to stricture of the urethra is caused, not merely by the narrowness of the canal, but also by muscular spasm and engorgement of the mucous membrane, superadded to the fibrous narrowing. Thus retention sometimes occurs with a stricture which, in ordinary conditions, will admit a No. 4 or even a still larger catheter. It must not, therefore, be assumed that the stricture is a very tight one merely because retention has occurred.

*Treatment.* The simplest method of affording relief should always be preferred. Frequently it is sufficient to place the patient in a hot hip-bath, and encourage him to pass water in the

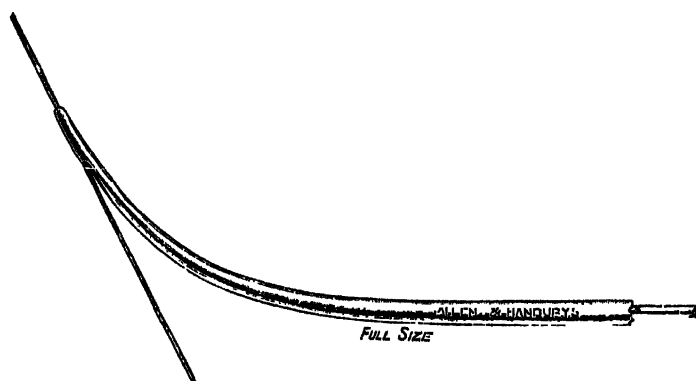


FIG. 73. Gouley catheter threaded upon its whalebone guide.

bath. If this fails, catheterization should be tried, and, if properly persisted in, will rarely fail. Paradoxical as it may seem, many failures are due to the attempt to pass too small an instrument.

It is best to begin with a No. 8 catheter, either of vulcanite or silver. The smallest silver instruments are dangerous even in practised hands, and should never be used; the small soft rubber catheters are safe, but often useless.

Under an anæsthetic it is often possible to pass a catheter after having failed without such assistance.

Before proceeding to operative measures the Gouley catheter (Fig. 73) should always be tried, and tried patiently. There are very few cases of retention due to stricture which cannot be relieved by means of this excellent instrument. The method of using it is as follows. An anæsthetic is of assistance, but is not absolutely necessary. The patient lies upon his back, with the

thighs slightly abducted. The surgeon stands at the right side and grasps the penis with his left hand, whilst with his right hand he passes one of the whalebone guides along the urethra until it is arrested. This is left in place, and a second guide is passed in the same manner, followed by a third, and so on until perhaps half a dozen have been passed. A little manipulation with each in turn will usually succeed in causing one or other of them to enter the stricture and pass on into the bladder. When this happens the rest are to be withdrawn, and the silver Gouley catheter passed along the guide as it lies projecting through the stricture. With this alone amongst urethral instru-

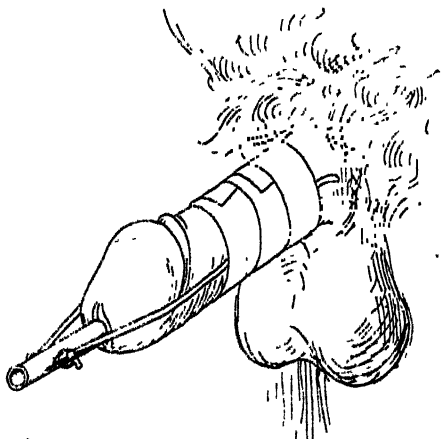


FIG. 74. Method of tying in a catheter.

ments may a little force be used, because, with the guide safely through the stricture, there is no risk of the instrument being forced through the urethral wall and causing a false passage. As soon as the silver catheter has entered the bladder the guide is withdrawn. Sometimes it is best to tie the catheter in for one or two days (Fig. 74), after which it is usually found that a larger instrument of the ordinary kind can readily be passed.

When the Gouley catheter is used carefully and patiently it rarely fails. Should it do so, and the means of performing a cutting operation for the relief of the retention are not at hand, it is permissible to perform suprapubic puncture (see p. 313). In these cases the urine is often septic, and there is some little risk of infecting the prevesical cellular tissue as the cannula is

withdrawn ; but circumstances of emergency sometimes arise in which such a risk has to be taken.

After the distension has been relieved, the patient will probably be able to pass water naturally, and the stricture itself can be deliberately dealt with later.

Operations which involve making an incision into the urethra are open to the objection that occasionally, in spite of all due care, an intractable urinary fistula results. The possibility of this deplorable sequela should be borne in mind in the treatment of urgent retention just as in the deliberate cure of a stricture by operation.

Cock's perineal puncture is a form of external urethrotomy for the relief of retention due to stricture, the necessity for which has been largely diminished since the introduction of the Gouley catheter. It is an operation simple and even dramatic in its performance, reasons which perhaps account for its former popularity, but it is attended by serious risks and a tedious convalescence. It has the further disadvantage of leaving the stricture untouched, unless it happens to lie in the path of the knife. Still, the operation is sometimes useful, particularly in cases complicated with extravasation of urine, false passages, free urethral hæmorrhage on instrumentation, and cystitis. It would therefore be indicated in a stricture case where no instrument could be passed, and where suprapubic puncture was contra-indicated by sepsis.

*Operation.* The pubes, scrotum, and perineum having been shaved and cleansed, the patient is placed in the lithotomy position and the left forefinger is introduced into the rectum until its tip is felt to rest against the apex of the prostate (Fig. 75). A long-bladed scalpel is then entered, edge forward, at a point one inch in front of the anus in the middle-line of the perineum, and thrust steadily inwards towards the tip of the left forefinger. As soon as the knife enters the distended urethra behind the stricture, the urine escapes in a forcible stream. The finger must then be withdrawn from the rectum and cleansed. It is a good plan to wear a rubber glove for the first part of the operation, which can be taken off at this stage, leaving the finger free from rectal contamination. The knife, still resting in the position in which it opened the urethra, is now transferred to the left hand, and a director is passed with the right along the blade into the bladder. If the knife is taken out before the director is in position it may be impossible to find the opening into the urethra. The knife having been removed, a catheter is introduced into the

bladder guided by the director, and secured in place with tapes. A special silver tube, with an adjustable collar, is made for this purpose, but if it is not available a large-sized gum-elastic catheter answers the purpose just as well.

*After-treatment.* The catheter is attached to a long piece of rubber tubing, by means of which the urine is drained into a vessel at the side of the bed. The patient should be given a daily bath, unless his general condition forbids it. Urotropin (5 grains three



FIG. 75. Cock's puncture.

times a day) should be given, and, if the urine is foul, the bladder should be washed out through the perineal tube with some mild antiseptic, such as permanganate of potash (1 in 2,000). If all goes well, the catheter is removed after a few days and the stricture dealt with either by dilatation or, better, by internal urethrotomy.

#### (c) *Prostatic Obstruction*

(i) Retention due to an enlarged prostate can almost invariably be relieved by catheter, provided that the proper instrument is used and that the anatomy of the distorted urethra is kept in

mind. In these cases the urethra is not only more curved, but

is also longer than normal, so that a catheter of ordinary length, even if it can be passed successfully along the urethra, may fail to withdraw urine simply because it is not long enough to enter the bladder.

In prostatic cases the small silver or ordinary olive-headed catheters should never be used. The failure to which they are doomed will probably be attended with urethral hæmorrhage, and may possibly be followed by extravasation of urine. The best instrument to use is the large silver prostatic catheter (Fig. 76 c), which is specially long and provided with a much larger curve than an ordinary catheter (Fig. 76 d). This instrument, especially when aided by a finger in the rectum, which should push the beak forwards, will rarely be found to fail. The gum-elastic coudé catheter (Fig. 76 b) will often succeed, but is not so generally useful as is the large silver instrument.

If catheterization should fail, on account of false passages or other causes, an anæsthetic should be given, and a further trial of the different kinds of catheters should be made.

In exceptional cases suprapubic puncture may be done, as, for instance, when the means of performing a cystotomy are not at hand, but as the urine is so often septic in these cases the pro-

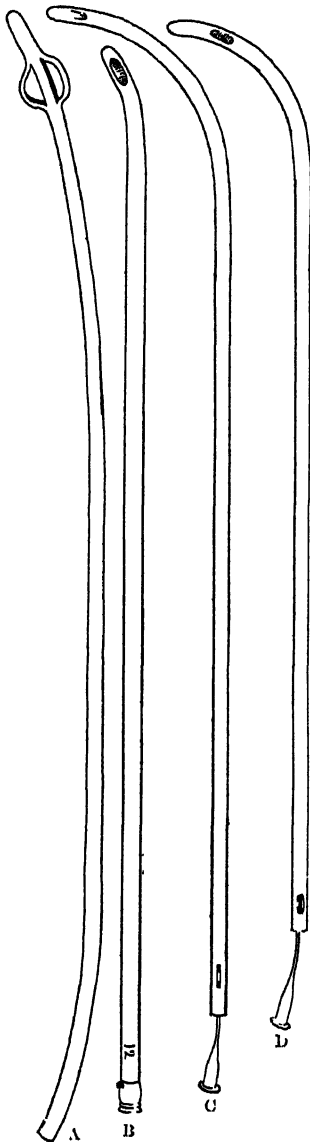


FIG. 76.

cedure is not devoid of risk. It is better to proceed at once with suprapubic cystotomy if instrumentation fails. This operation

allows the septic bladder to be drained and irrigated with ease, and permits a digital examination to be made for the presence of a stone which not infrequently complicates prostatic enlargement with cystitis. At the same time an opinion can be formed as to the advisability of performing prostatectomy at a later-period.

*Suprapubic cystotomy. Operation.* The full bladder, in cases of retention, makes this a very easy operation. The pubes having been shaved, and the lower part of the abdomen cleansed, a vertical incision, from three to four inches long, according to

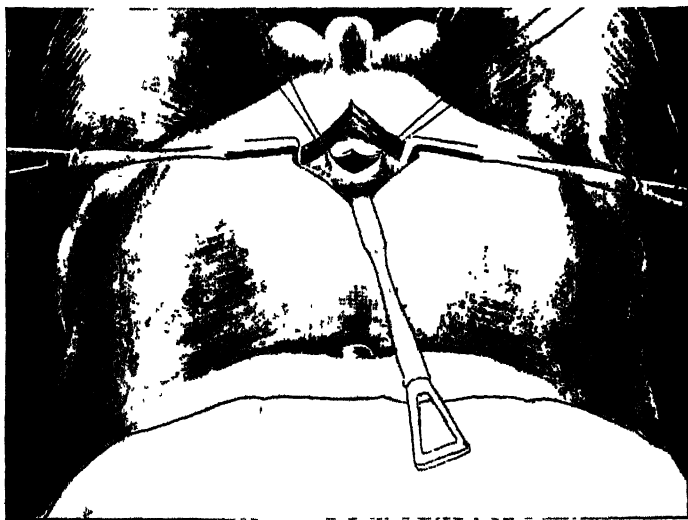


FIG. 77. Suprapubic cystotomy.

the amount of fat on the abdominal wall, is made in the mid-line immediately above the symphysis (Fig. 77). The interval between the rectus muscles is found, and the prevesical space opened into. The next step is to make quite sure that the peritoneal reflexion from the superior surface of the bladder on to the abdominal wall is identified, and then to hold it upwards out of the way with a broad retractor. Two stout silk threads are next passed through the muscular wall of the bladder, one on either side of the proposed incision, to act as guides and to prevent the bladder falling back as it empties. The bladder must now be opened by a vertical incision between the two guide sutures, taking care to avoid, if possible, wounding any of the large veins

which are generally present upon it. The organ is thus emptied, explored with the finger, and, if cystitis is present, thoroughly washed out with hot saline or permanganate solution. A rubber drainage tube is next inserted, and the wound in the bladder partly sutured around it. One of the best forms of tube for this purpose is that of Guyon (Fig. 78), which is self-retaining, and can be adjusted, by means of the sliding collar, so as to project to any desired distance into the bladder. This tube, when connected with a receiver at the side of the bed, usually acts so efficiently that there is little or no leakage into the dressings

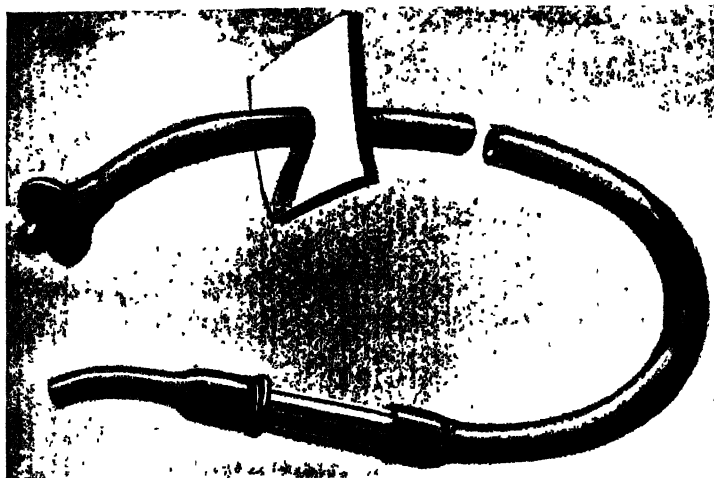


FIG. 78. Guyon's suprapubic tube.

around it. Another excellent plan for draining a suprapubic wound, especially after prostatectomy, is by means of Hamilton Irving's apparatus (Fig. 79).

(ii) *Inflammatory enlargement* of the prostate sometimes causes retention of urine. These cases are usually examples of acute gonorrhoeal prostatitis, or abscess of the prostate associated with some septic condition of the urine. In the former, a hot hip-bath will usually make the patient succeed in passing urine, but, if it fails, a catheter may have to be passed. In abscess of the prostate the catheter may also be necessary, and sometimes its use is followed by evacuation of the abscess *per urethram*. If not, the abscess will require to be opened by the perineal route. For this purpose an incision is to be made into the perineum an inch in front of the anus, and in the mid-line. Assisted by

a finger in the rectum, a pair of sinus forceps is thrust towards the prostate until the pus is reached. The opening is then enlarged and a drainage tube inserted.

Other forms of peri-urethral abscess may cause urinary retention, and require treatment similar to that of prostatic abscess.

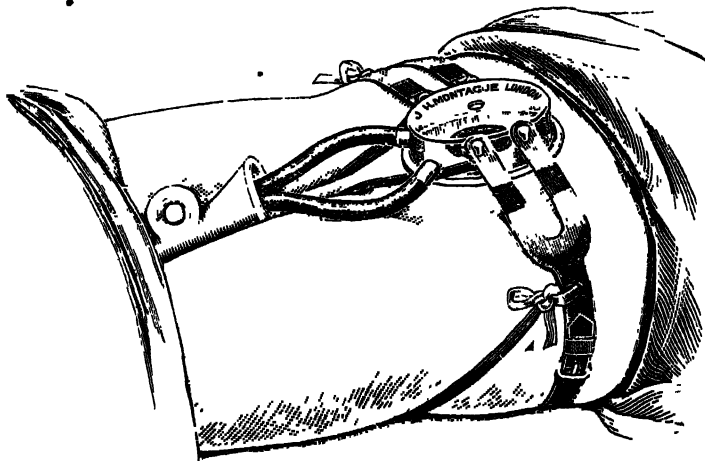


FIG. 79. Hamilton Irving's suprapubic drainage apparatus.

(d) *Retention due to urethral and vesical injury.* These conditions are dealt with in the section on perineal and pelvic injuries (Chapter XV).

(e) *Impacted calculus and foreign bodies in the urethra.* See p. 179.

## II. EXTRAVASATION OF URINE

Closely related to the subject of retention is that of urinary extravasation, which may rightly be regarded as one of the most pressing of all emergencies. In spite of the seriousness of the condition, especially if cystitis is present, it is surprising how often apparently desperate cases can be saved by energetic treatment. The most favourable cases are those due to urethral injuries in the young and previously healthy; the least favourable are those which result from stricture and prostatic enlargement in the old and debilitated, and those in which the urine is septic.

The *diagnosis* of urinary extravasation usually presents no difficulty. There is the history of injury or of difficulty in micturition; often the full bladder of retention; locally, in the



early stage, a soft boggy swelling in the perineum, which swiftly increases in extent by passing upwards into the tissues of the scrotum, penis, and abdominal wall. When the extravasation results from rupture of the urethra behind the triangular ligament, or from extra-peritoneal rupture of the bladder, the swelling will appear, not in the perineum but above the pubic bone and Poupart's ligament.

If the case be not dealt with at once, the skin rapidly becomes reddened and cedematous, and soon passes into a gangrenous condition, with perforation and leakage of foul pus and urine through the sinuses. Whilst these changes are taking place, the constitutional condition rapidly becomes one of great gravity; high fever, with its attendant symptoms, is shortly followed by the extreme toxic condition known as the 'typhoid state', with very irregular temperature, rigors, delirium, and collapse.

*Treatment.* The first indication is to provide free drainage from the bladder, so as to prevent any further extravasation; the second is to provide free exit for the urine that has already escaped into the cellular tissue.

The first object is attained in traumatic cases by cutting down upon the torn urethra and suturing it over a catheter; in stricture cases by division of the stricture and tying in a catheter, or by a Cock's perineal puncture; and in prostatic and certain other cases by suprapubic cystotomy.

The treatment of the extravasation itself, after providing for bladder drainage, consists in making free incisions into the infiltrated cellular tissue, the size, number, and position of which are indicated by the extent and situation of the extravasation. At the time of this operation it is usual for the incisions to bleed somewhat freely, so that they have to be plugged with gauze strips. But as soon as the hæmorrhage has ceased they require neither plugs nor drainage tubes. On the day after the operation the patient should be placed in a warm boracic bath, and allowed to remain in it for twenty minutes, or longer if he can stand it. Such treatment, particularly in the old and feeble, requires very careful supervision, as patients sometimes become very collapsed in a bath. The bath treatment should be continued daily until the wounds have nearly healed. In the meantime, stimulants and general tonic treatment are required, and a careful watch must be kept for any signs of spread of the cellulitis. Should such occur, more incisions must be made.

## III. CATHETER FEVER

After urethral instrumentation of any kind a patient may suffer from what is known as 'catheter' or 'urethral' fever, which may be slight or severe in character. A mild attack may be represented by nothing more than a slight shivering fit with a transitory elevation of temperature; a severe one by a succession of rigors, accompanied by severe constitutional symptoms, diminution or even suppression of urine, and uræmia.

In most cases the symptoms are undoubtedly due to septic absorption, and this fact indicates the lines upon which treatment must be carried out. Urotropin should be given by the mouth, and the bladder and urethra should be irrigated with an antiseptic solution, such as boracic acid, or permanganate of potash (1 in 2,000). In order to avoid the passage of an instrument, and at the same time to wash the urethra as well as the bladder, this irrigation may be carried out by hydrostatic pressure. A catheter, attached to an irrigator, is introduced into the meatus, and the irrigator elevated a couple of feet, sufficient to overcome the resistance of the sphincter vesicæ and allow the solution to flow into the bladder. If these measures fail to give relief it may become necessary to open and drain the bladder. Should suppression and uræmia occur, the treatment proper to these conditions must be carried out (p. 328).

## IV. EMERGENCIES CONNECTED WITH NEPHRITIS

Nephritis assumes many forms, but only those conditions will be mentioned in which the symptoms call for immediate treatment. The diagnosis is usually fairly obvious, particularly when urgent symptoms are present.

(i) *Acute nephritis with scanty or suppressed urine.* No specific treatment being available, the kidneys must first be shielded as far as possible from all work. The skin must be made to act as freely as possible, and with this end in view a hot bath should be given for about fifteen minutes at a temperature not exceeding 105° F. The patient should not be left alone in the bath, and should subsequently be put to bed between blankets and warmly covered. This hot bath may be repeated daily; or a hot-air bath, if the appliance is available, at a temperature not exceeding 150° F., may be given instead. The skin in nephritis is sometimes very dry, and may fail to respond to the bath treatment. It is usual to give a hypodermic injection of one-sixth of a grain of pilocarpin nitrate for an adult, but the wisdom of

this treatment is questionable, as the drug is excreted by the kidney. It should, at any rate, be used with caution in acute cases, and must not be given in the presence of any bronchitis or œdema of lung, on account of its action in increasing secretions other than sweat.

A large linseed and mustard poultice may be applied to the loins, or, in a severe case, cupping may be done. This is easily effected by putting pieces of blotting-paper soaked with methylated spirit into a tumbler, setting them alight, and applying the tumbler to the back over the kidney region whilst the paper is alight. A large swelling rapidly forms in the tumbler, which may then be removed by depressing the skin at one point near its rim, so as to allow access of air to its interior. Leeches may be applied in the same position.

In a very severe case venesection should be performed and fifteen or twenty ounces of blood withdrawn. The amount of toxin circulating in the blood is thereby diminished, and may further be diluted by intravenous infusion of normal saline. If there is little or no œdema, two or even three pints of saline may be given in the case of an adult.

*Diuretics.* The value of diuretic drugs is questionable. As the kidney is acutely diseased rest is highly desirable, so that drugs having any action on the renal epithelium should be used very sparingly.

*Food.* In a severe case all food should be withheld for one or two days. This will ensure as complete rest for the kidney as can be given. In less severe cases milk may be allowed, a pint or two for the first few days. As the kidney is concerned with the excretion of nitrogenous material, food should consist in the main of carbohydrates and fats; rice-pudding and bread and butter are therefore desirable food-stuffs to add to milk. No salt should be added to any food. When œdema is slight or absent, water may be allowed fairly freely.

(ii) *Renal dropsy.* The fluid intake should be reduced to a minimum, hot baths should take a more prominent part in the treatment, and the bowels should be kept open very freely. If dropsy is extreme, small punctures may be made after very careful cleansing of the skin. The limb should be wrapped up in antiseptic wool, which should be changed frequently.

In chronic nephritis diuretics are less open to objection than in the acute disease. Liq. ammon. acetat.  $\frac{3}{4}$  ss., and pot. acet. gr. x, may be given every six hours. Caffein citrate is often used; it may be given in 5-grain doses every six hours.

(iii) *Uræmia*. This condition may develop in any form of nephritis, but is most common in chronic types. It may assume various forms, and may come on suddenly or be preceded by headaches, sickness, and twitchings.

Its chief manifestations are cerebral, respiratory, and gastro-intestinal.

The cerebral forms include headache, convulsions, and coma ; mental disturbances, transient amaurosis, and local paralyses are also not uncommon.

The respiratory manifestations comprise dyspnœa, paroxysmal dyspnœa or renal asthma, and Cheyne-Stokes breathing.

The chief gastro-intestinal manifestation is vomiting.

*Uræmic headache*. This may be a very troublesome symptom apart from its occurrence just prior to the development of acute uræmia. It probably results from increased intracranial pressure. General measures, such as purgation and baths, should first be tried. Rose Bradford considers pilocarpin nitrate to be the best remedy, and gives it by the mouth two or three times daily in doses of a sixth of a grain. Nitro-glycerine in 2-minim doses three times a day is sometimes very useful, and when the headache is merely the result of a high blood-pressure its use may be very beneficial ; but when the high blood-pressure is simply a compensatory process to ensure a free cerebral circulation when the intracranial pressure is raised, it may do considerable harm. It should therefore be given cautiously, and immediately stopped if the symptoms become worse.

*Uræmic convulsions*. The onset of uræmic convulsions is sometimes heralded by headache, furred tongue, muscular twitchings, and restlessness. A free purge and hot baths often seem to ward off the approaching convulsions. When they occur they may usually be checked by inhalations of chloroform. Many cases are on record in which marked relief has attended the withdrawal of cerebro-spinal fluid by lumbar puncture ; the fluid is often under considerable pressure, and if so an ounce may be removed, and the operation repeated if necessary. The procedure is described on p. 8.

Venesection is sometimes very beneficial. The skin should be kept acting by means of hot-air baths or wet packs ; the wet pack is the more accessible. The patient is wrapped up in a blanket wrung out of hot water, and covered with several dry blankets ; after an hour he must be thoroughly dried and wrapped up again in warm dry blankets.

If convulsions recur, or if the symptoms are mainly those of

restlessness, delirium and headache, morphia is invaluable. It is best given hypodermically, in small doses, and repeated if necessary.

*Uræmic coma.* Lumbar puncture should be performed at once. Wet packs should be employed. An injection of pilocarpin nitrate (gr.  $\frac{1}{8}$ ) should be given. If no improvement follows, venesection followed by intravenous infusion of normal saline should be tried. Harvey Cushing relates a case in which the performance of a decompressive operation (see p. 346) yielded excellent results by relieving the increased intracranial pressure which seems to be present in uræmia.

*Uræmic dyspnœa.* In the first place it is essential to make sure that the dyspnœa is not the result of hydrothorax, in which case aspiration is demanded. Morphia is the most valuable drug, and often gives complete relief.

*Uræmic asthma.* It is difficult to define this term. In cases of arteriosclerosis with contracted kidneys, attacks of urgent dyspnœa and distress are not uncommon, and may owe their origin to one or more of several factors, such as stimulation of the respiratory centre, attacks of cardiac failure, and bronchitis or œdema of lungs. Morphia is invaluable, and the cardiac condition may be improved by digitalis and ammonia. Venesection should be performed in severe cases.

## V. RENAL COLIC

The importance of accurate diagnosis in all forms of acute abdominal pain is dealt with in Chapter XIII. When all the classical symptoms of renal calculus are present, namely, pain in the flank radiating down the ureter towards the groin, together with hæmaturia, the diagnosis of pain arising in the kidney is obvious. But it by no means follows that a stone in the ordinary sense of the term is present. Still, in the presence of an agonizing attack of renal pain, with sweating and vomiting, the diagnosis of renal calculus may be made provisionally.

*Treatment.* A hypodermic injection of morphia must be given and repeated if necessary. Inhalations of chloroform may be required in very severe cases. A hot linseed poultice frequently gives great relief, and a hot bath may be tried.

If the stone is small, it may descend the ureter rapidly and ultimately be passed *per urethram*; or it may be arrested in the renal pelvis or in the ureter. If, after the attack of renal colic is over, no stone has been passed, steps must be taken to confirm

the diagnosis of stone, and, if present, its situation. The removal at an early date of a stone impacted in the ureter is imperative, not only on account of the liability to repeated attacks of severe pain and constant discomfort, but on account of the danger of destruction of the kidney by back-pressure and pyelitis.

### *Renal Colic in the Absence of Stone*

(a) *Urinary abnormalities.* True attacks of renal colic may occur in the absence of stone in the ordinary sense of the term. They are due to the deposition of showers of crystals, either of uric acid, oxalate of lime, or phosphates. Hæmaturia may occur. Often the pain is situated in the loin and is more of an aching character, but actual colic does occur. The attack may be very transient and X-ray examination negative. The presence of uric acid gravel, of oxaluria, or of an abundant deposit of phosphates, may settle the diagnosis. Such patients are, of course, liable to the development of true calculi.

*Treatment.* If the attack is severe, morphia may be required, together with hot local applications. General treatment is of the greatest importance, and is fully described in the textbooks. In brief, the general hygiene of the patient should be rigidly supervised. In cases of uric acid gravel or oxaluria, meat should be restricted and alkalies given. A course of Contrexoville waters is often most beneficial. With phosphaturia, urotropin (gr. x), with acid phosphate of soda, gr. xx. three times daily, often gives immediate relief.

(b) *Movable kidney.* Attacks of true renal colic with hæmaturia also occasionally occur in cases of *movable kidney*, and are probably caused by kinking of the ureter and vessels, with consequent engorgement of the organ. At the time of the attack such a case may be indistinguishable from one of colic due to calculus, and would require the same immediate treatment. The diagnosis would require to be made afterwards on other grounds, such as history, presence of movable kidney, and negative X-ray examinations.

(c) *Tumour of kidney and tuberculous kidney.* Occasionally the passage of blood, fragments of growth, or tuberculous material along the ureter, gives rise to attacks of renal colic. Such attacks are rarely of great severity, and require the same treatment as those due to stone.

## VI. SUPPRESSION OF URINE

The importance of a careful examination for a distended bladder is obvious, but the warning is not out of place, as retention of urine has frequently been mistaken for suppression.

The chief condition leading to suppression of the secretion of urine has been dealt with under Acute Nephritis. Two others require brief mention.

(i) *Calculous anuria*. This condition is commonly due to the impaction of a stone in one ureter, the other kidney being already functionless from disease. It sometimes occurs when the other kidney is normal. After an attack of colic the pain may subside, from the stone having become impacted in the ureter; or the onset of calculous anuria may not be heralded by any attack of colic. No urine is passed, yet at first no serious symptoms present themselves, and the patient may not seem to be seriously ill for some days. Sooner or later, headache, restlessness, and twitchings occur, and the other symptoms of uræmia gradually appear. In the presence of such anuria operation is urgently demanded, for, if delayed too long, the kidney may fail to secrete urine despite the removal of the obstruction.

*Operation of nephrotomy*. The side to be operated upon is indicated by the situation of the pain. In the absence of any such guide it may be necessary to explore both kidneys.

The patient lies upon the opposite side with a cushion beneath the loin. An incision four or five inches in length is made downward and forwards, commencing at and bisecting the angle between the outer edge of the erector spinæ and the last rib. The muscular and fascial layers are divided in the same direction until the peri-renal fat is reached. The kidney is then freed from its bed by working round it with the fingers, and is brought up to or out of the wound. If the stone can be felt in the renal pelvis or the upper end of the ureter, an incision should be made over it, and its removal followed by exploration of the ureter by means of a long bullet-probe. If the stone cannot be reached in this manner, the kidney must be incised along its outer convex border, and the incision deepened until the renal pelvis is reached. The free hæmorrhage which occurs at this stage is readily controlled temporarily by grasping the pedicle, and permanently by passing catgut sutures right through the substance of the kidney so as to bring the cut surfaces tightly together. After removal of the obstruction, the wound should be packed with strips of gauze around a drainage tube, and only partly closed, so as to allow

of the free exit of urine through it. If the ureter is free from obstruction the urinary fistula will close spontaneously.

(ii) Suppression is occasionally met with after operations upon the urethra, bladder, and kidney. In these cases the anuria is due only to functional inactivity of the kidney from a reflex cause, and every effort should be made to stimulate secretion. Diuretics should be given, freely diluted, such as liq. ammon. acetat.  $\bar{z}$  ss., pot. cit. gr. xx, and infus. buchu ad  $\bar{z}$  i, every four hours. The bowels should be freely opened by a saline purge, and hot fomentations or cupping applied to the loins. Finally, an intravenous infusion of saline may be given.

#### VII. HÆMATURIA

Hæmaturia is either traumatic or pathological. The traumatic cases are readily distinguished, and are dealt with under abdominal and pelvic injuries (Chapter XV).

It is not proposed to discuss the causes and treatment of the appearance of small or microscopical quantities of blood in the urine. Such cases cannot be termed emergencies. It is rather with the cases in which blood is passed in large and even alarming quantities *per urethram*, or in which the bladder becomes filled with blood-clot, that we are concerned.

The treatment necessarily depends upon the cause, and the first thing to do when called upon to deal with a case of hæmaturia is to ascertain the *source* of the blood, even if it is not possible to make an accurate diagnosis, as, for instance, between tumour and ulceration of the bladder.

The blood may proceed either from the kidney, the bladder, or the urethra. In a general way the source can be ascertained by observing at what period of the act of urination the greater quantity appears. If it is unconnected with micturition, or comes principally at its commencement, the hæmorrhage is urethral: if at the end of micturition, vesical: and when no difference in the colour of the urine passed can be detected throughout the act, the source is probably renal.

A careful inquiry into the history, together with these and other signs to be detected upon examination, should enable a correct diagnosis to be made.

(a) *Urethral hæmaturia.* Apart from injury, it is uncommon for blood to escape in any great quantity from the urethra, although some cases of prostatic enlargement are subject to considerable urethral hæmorrhages. An actual attack of hæma-



turia of this nature requires no active treatment, as the bleeding is rarely severe or long continued, but it should be taken as an indication that radical treatment may be necessary later.

The commonest variety of urethral hæmorrhage, apart from accident, is that which may occur after internal urethrotomy. It may be very severe and persistent, but it can generally be controlled by placing a pad of folded lint, about the size of the fist, against the perineum and fixing it firmly in place by means of a T-bandage. This compresses the posterior urethra against the pubic arch and triangular ligament. If the bleeding comes from further forward in the urethra, so as to be uncontrolled by this simple device, the penis may be bandaged against a narrow finger-splint placed along its ventral aspect.

(b) *Vesical hæmaturia*. The common causes are stone, tumour, ulceration, and prostatic enlargement.

Enlarged prostate is readily detected and may be responsible for vesical hæmaturia in two ways.

(i) By giving rise to chronic retention with thickening of the walls of the bladder. Rapid emptying of the bladder, especially when an acute distension is added to the chronic state, is apt to cause hæmorrhage from rupture of vessels in the vesical wall. Such an accident should be guarded against by avoiding the too sudden emptying of an over-distended bladder. When it does occur, it is best treated by complete rest in bed, together with sedatives (not opium), followed by bladder-washing to remove clot and débris. There is some danger of suppression of urine, and if there is any sign of this, the loins should be cupped and pilocarpin administered, the bowels being at the same time kept freely open with saline aperients.

(ii) Sometimes blood derived from an enlarged prostate finds its way into the bladder, which may become distended with blood and clot and require immediate suprapubic cystotomy for its complete evacuation. The presence of blood-clot in the bladder in any quantity calls for active treatment, as infection and decomposition are apt to appear very rapidly, with grave results. It is not permissible to wait for the clot to become broken up and evacuated spontaneously: it must be removed before infection has occurred, either by washing with a double channelled catheter or an evacuator, or by cystotomy.

In the absence of prostatic enlargement, the history will often point to the presence of stone and the passage of a sound will speedily determine its presence. Lithotritry or lithotomy would be indicated.

In the absence of these obvious indications the possibility of tumour or ulceration must be considered. In tumour, hæmaturia is the first and often the only symptom. It is apt to recur at varying intervals, and the total loss of blood may be sufficient to produce extreme anæmia. With ulceration, pain and frequency of micturition are more prominent than the hæmaturia. Naturally the diagnosis can only be made by cystoscopic examination or exploratory suprapubic cystotomy, and the treatment must be determined by these findings.

Finally, hæmorrhage from the bladder may occur apart from any of the above-mentioned causes, and its exact nature may not be ascertainable. It is possible that a vein may burst, or that an artery may be ruptured in cases of high blood-pressure associated with general arterial disease and chronic nephritis. Such a condition is probably the cause of some cases of unexplained hæmaturia. Fortunately the bleeding usually ceases spontaneously, and active local treatment is not called for.

(c) *Renal hæmaturia*. The common causes are stone and tumour; the less frequent are tuberculous disease, nephritis whether acute or chronic, hæmophilia and other blood diseases. The cause should first be determined, and next whether one or both kidneys are involved.

The history of the case will often suggest the presence of a stone, and the diagnosis may be settled by a skiagram. In tuberculous disease pus is usually present in the urine and the hæmorrhage is often slight. In tumour of the kidney the organ is enlarged and hæmaturia often a very prominent feature of the case, sometimes with blood-casts of the renal pelvis and ureter. The kidney is often enlarged both in calculous and tuberculous disease, but the associated symptoms usually indicate the nature of the disease.

The presence of tumour indicates the kidney affected, but in the absence of this sign and of unilateral pain, it may be necessary to employ the cystoscope to determine from which ureter the blood is derived.

In nephritis the associated symptoms, such as œdema and the presence of casts, give a sufficient clue for diagnosis.

Direct treatment for renal hæmaturia is, from the nature of the conditions giving rise to it, seldom called for. The patient should be put to bed. Acetate of lead, dilute sulphuric acid and opium (in the absence of nephritis) may be given. If susceptible of surgical relief the kidney should be explored, and stones removed or nephrectomy performed. In nephritis the ordinary treatment for that condition should be adopted.

*Hæmaturia after nephrotomy.* Sometimes after operations in which the kidney has been incised, a large quantity of blood is passed *per urethram*. As a rule this hæmorrhage ceases spontaneously after two or three days, but occasionally the amount lost may be so great as to cause alarm. The use of drugs in such a condition is of doubtful value. Still, calcium lactate (gr. xx), liquor hamamelidis (ʒj), or small doses of opium may be tried. When the hæmorrhage persists so as to threaten life, excision of the kidney is the only treatment likely to be of any avail.

#### VIII. ACUTE CYSTITIS

Cystitis may be primarily acute, or it may supervene upon a chronic inflammation of the bladder associated with stone, stricture, or prostatic enlargement. It occurs at all ages, even in early infancy, and the primary cause is in all cases bacterial infection. The colon bacillus is by far the commonest organism present, but the pyogenic cocci, the gonococcus, the typhoid bacillus and other bacteria are also occasionally found.

The chronic forms of cystitis do not here concern us. Acute cystitis, on the other hand, presents symptoms of great severity and urgency which call for immediate relief. The treatment at this stage is the same in all cases, but at the same time the exciting cause must be sought for in a bacteriological examination of the urine freshly passed into a sterile vessel. Armed with this knowledge the practitioner is in a position to apply, if necessary, the appropriate vaccine or serum treatment. -

Predisposing causes must also be looked for, such as stone, stricture, and prostatic enlargement, in order that these may be radically dealt with on the subsidence of the acute attack.

The chief *symptoms* are severe hypogastric pain and tenderness, accompanied by an almost continuous urgent desire to pass water. A patient in this condition may be in very great distress, though, apart from that, the constitutional symptoms are usually not very severe. Unless the kidneys are affected, there is little or no elevation of temperature, and the main symptoms are merely those of a general malaise.

The urine may be acid in an acute case, but is more frequently alkaline; it contains pus, often withropy mucus, and may be horribly offensive; blood is often present in small amount, and occasionally there is sufficient to colour the urine deeply.

*Treatment.* The immediate indication is to relieve the urgent symptoms of pain and constant straining to urinate. The

important thing to remember is that no attempt must be made, in the acute stage of cystitis, to irrigate the bladder. Frequent hot hip-baths give great relief, as also do hot fomentations to the hypogastrium and perineum.

A belladonna suppository may also give relief. The patient should be put to bed, and kept upon a strictly milk diet for a few days. The drugs which will be found useful are saline aperients, hyoscyamus, and infusion of buchu.

In acute inflammation of the bladder complicating prostatic obstruction or vesical calculus, suprapubic cystotomy may be done without awaiting the subsidence of the acute cystitis. In stricture cases, with urinary obstruction, urethrotomy may have to be done at once. But in most cases it is both possible and advisable to await the subsidence of the acute symptoms, and then to deal at leisure with the cause.

#### IX. PARAPHIMOSIS

The longer this condition is left unrelieved, the more difficult is its reduction, and in a bad case ulceration and sloughing rapidly

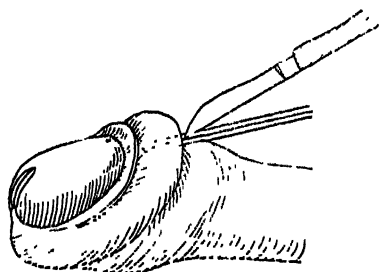


FIG. 80. Division of the constriction in paraphimosis.

follow upon the oedema of prepuce which takes place anterior to the constriction. Reduction can be effected in a slight and early case without an anæsthetic, but in the more severe and neglected cases a general anæsthetic is required. Reduction is facilitated by making a number of small punctures into the swollen mucous membrane, and squeezing the fluid out through them. When this has been done, the penis should be grasped in such a way that the fore and middle fingers of each hand embrace the organ behind the constriction, and form a point of support against which the thumbs are able to make firm and steady pressure upon the glans. It is sometimes necessary to divide the constriction, and this is done, as shown in Fig. 80, by means of

a director and scalpel, after which reduction is effected in the ordinary manner.

A lead lotion dressing is indicated afterwards, but in a case with ulceration and sloughing bath treatment is best.

#### X. ACUTE EPIDIDYMITIS      •

In the great majority of cases due to gonorrhœa, this condition sometimes occurs as a sequel of catheterization, cystitis, and operations upon the urethra, prostate and bladder. It is accompanied by extreme pain and often by severe constitutional disturbance. It is best treated by rest in bed and hot fomentations, the scrotum being supported upon a pillow. As a rule the inflammation subsides without abscess formation, but it is necessary to keep a watch for signs of suppuration, and to make incisions as soon as the presence of pus is suspected. Some advocate early incision without waiting for signs of pus formation, believing that, in addition to the immediate relief of pain, less destruction of the epididymis results, and that therefore the prospect of sterility is diminished. The incisions should be made through the red cedematous skin at the back of the scrotum. Free bleeding is to be expected, but this will readily be controlled by plugging.

#### XI. TORSION OF THE TESTIS

In the great majority of cases torsion of the testis is associated with imperfect descent of the organ, and its acute onset is often determined by some exertion or injury. The signs and symptoms closely resemble those of a strangulated inguinal hernia, so that the condition is usually diagnosed as such in association with imperfect descent of the testis. Intense pain is present, together with vomiting and the presence of a tense tender swelling in the groin, probably in the inguinal canal, and devoid of impulse on coughing.

Correctness of diagnosis is not of supreme importance, except from the point of view of prognosis, and of informing the patient's friends of the necessity to remove the testis. It is, even if the case can be diagnosed correctly, futile to try to untwist the cord subcutaneously. Operation is urgently called for, and should be proceeded with as for strangulated hernia. If the twist is slight, and the congestion trivial, an attempt may sometimes be made to preserve the testis, but as a rule it is best to remove it at once, because even if the testis does not slough after

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such an attempt to preserve it, it will probably atrophy and become functionally useless. In removing the testis, the cord should be transfixed and ligatured, and the inguinal canal sutured as in doing a radical cure of hernia.

The occurrence of epididymitis and orchitis as an occasional complication of mumps is well known. This would call for no special mention as an emergency except for the occasional association with it of extremely urgent and alarming symptoms. Sidney Phillips has related a case in which rigors, high fever, violent delirium, and severe collapse occurred as each testis in turn, at an interval of five days, became affected. W. S. Mitchell relates the case of a negro in whom an undescended testis was thus affected, producing violent mania together with acute abdominal symptoms.<sup>1</sup>

<sup>1</sup> *Lancet*, January 7, 1911.

## CHAPTER XVIII

### INJURIES OF THE NERVOUS SYSTEM

ALL injuries to the nervous system, whether slight or severe, should be looked upon in a serious light, and the greatest caution should be observed in giving a prognosis. Much depends upon promptness of diagnosis, and upon the measures which are adopted from the very outset.

There are many cases which require immediate operation in order to save life, and many more in which the delay of even a few hours may cause irreparable mischief. For example, the immediate suture of a divided nerve is followed by far better results than if the operation is delayed; and it can scarcely be doubted that some cases of fracture of the spine could be saved by prompt action, which now are allowed to die untreated, or in which laminectomy is performed as a forlorn hope some weeks after the accident.

#### I. CRANIAL INJURIES

Injury of the brain and fracture of the skull are so closely related that they must be considered together. There is, however, no constant relation between the two in point of severity, for gross lesions of the brain may follow accidents in which the skull is not fractured, and extensive fractures of the skull are sometimes sustained without giving rise to any cerebral symptoms at the time, although it is probably very rare for the subject of a fractured skull to escape completely all the possible consequences, both immediate and remote. The slighter evidences of gross lesions may escape notice unless very carefully looked for; whilst mental and neurasthenic sequelæ are common. Again, severe cerebral symptoms may attend an injury which causes no gross lesion of the brain, as in the condition known as concussion, and it must be remembered that every gradation exists between this condition and the most extensive lacerations of the brain substance.

A difficulty which frequently arises is that of distinguishing between cases in which the cerebral symptoms are due to the

injury, and cases in which scalp wounds or even fractures of the skull have been sustained in consequence of a fall due to sudden loss of consciousness from some totally different cause. For example, the subject of a cerebral embolism may, in falling, sustain a fracture of the skull.

A clear history from a reliable witness, if obtainable, may be of considerable value. But it frequently happens that a patient is found unconscious, and that no such assistance is available. In such a case a careful examination must be made to determine the presence or absence of disease capable of producing unconsciousness. In the absence of any such indication the presumption is that injury is responsible for the condition.

For the method of investigation of a case of unconsciousness, see p. 358.

If it has been decided that the cerebral symptoms are consequent upon the injury, it is clearly necessary to make a diagnosis of the nature and site of the lesion. In this connexion it is convenient to consider head injuries as a whole, including fracture of the skull with or without cerebral symptoms, and injuries of the brain with or without fracture of the skull.

#### EXAMINATION OF A CASE OF HEAD INJURY

(a) *Scalp wound.* If a scalp wound is present, hæmostasis and cleansing must be proceeded with at once on general lines. When the wound has been cleansed as thoroughly as possible, and not until then, it must be examined with probe and finger, under strict aseptic precautions, to find whether a fracture underlies the injured scalp, and whether any foreign body remains lodged in the wound.

(b) *External hæmorrhage.* The escape of blood from the ear naturally suggests a basal fracture implicating the middle fossa, but it should not be too readily assumed that this is the case, as a ruptured membrana tympani alone may cause quite a considerable amount of hæmorrhage from the meatus. Persistent bleeding, together with the presence of other confirmatory circumstances, points to the more serious injury, whilst the simultaneous escape of cerebro-spinal fluid would render the diagnosis clear. •

The same caution must be observed in deciding upon the significance of hæmorrhage from the nose, whether appearing through the nostrils, or escaping into the pharynx and being subsequently vomited.



Subcutaneous hæmorrhage appearing two or three days after the injury, is of great diagnostic value. The situations in which it is to be looked for are beneath the lower part of the conjunctiva in fracture of the anterior fossa, and over the mastoid process in fracture of the posterior fossa.

(c) *Cranial irregularities.* The vault and all bony prominences of the skull must be palpated, and the two sides carefully compared. Thus a depressed fracture may be recognized, but care must be exercised not to mistake natural irregularities for fractures.

(d) *Consciousness.* The duration and degree of any loss of consciousness are important, though it must not be forgotten that very serious injuries to skull and brain are sometimes attended by no loss of consciousness whatever.

In *concussion*, the loss of consciousness which is the outstanding feature of this condition is sudden, and often of only brief duration. It is rarely so profound but that strong sensory stimuli will elicit some sort of response. In *compression* of the brain, the loss of consciousness, unless attended by preliminary symptoms of concussion, is gradual, and as time goes on it becomes deeper and deeper, until no sensory stimulus will elicit any response, and, if unrelieved, the coma deepens until death ensues. A patient may lose consciousness for a short time from concussion, then recover, and finally sink into a state of coma from the compression of an intracranial hæmorrhage.

(e) *Examination of the eyes. Pupils.* In concussion, the pupils are equal, and react sluggishly to light. Any inequality, particularly if persistent, points to a gross lesion of some kind as distinct from concussion. In compression they are often unequal, and tend to become progressively more dilated and inactive to light.

*Paralysis of any of the ocular muscles* points to gross injury, either central, or affecting the trunk of the corresponding nerve in some part of its course.

*Proptosis* may be due to hæmorrhage into the orbit, but may also indicate injury to the cavernous sinus, particularly when associated with ocular paralysis.

(f) *Motor system.* Any rigidity, paralysis, or spasm of muscles must be carefully looked for. In a patient deeply comatose from intracranial hæmorrhage, especially when the ventricles are flooded, the whole muscular system is usually flaccid: the limbs lie helplessly in any position in which they may be placed; the soft palate flaps to and fro with the respiratory movements,

causing stertorous breathing ; and the cheeks are drawn in with inspiration and blown out with expiration.

In a case of cortical hæmorrhage convulsions usually attend the onset ; these are commonly unilateral, and the limbs on the opposite side of the body may be first rigid and then flaccid. In an unconscious patient it may be difficult to be sure whether the more rigid side is really rigid as compared with a normal side, or normal as compared with a flaccid side. Complete flaccidity of the limbs of one side indicates hemiplegia. It is shown by the limbs falling more 'dead' than do those of the unaffected side when lifted up and allowed to drop. An initial transient rigidity may occur.

When the symptoms due to an intracranial hæmorrhage are progressive, it is of the utmost importance to watch their course carefully, in order to form an opinion as to the proper site for operation. For instance, deepening coma with twitching of one side of the face and arm, coming on an hour or two after a severe head injury, would point to the probability of hæmorrhage spreading upwards from the base over the cortex.

Weakness or paralysis of one side of the face would be due to injury of the nerve trunk ; if occurring together with weakness of the arm on the same side, it would probably be due to a lesion of the opposite cortex.

(g) *Sphincters*. The passage of urine at the time of an injury has little significance. It not infrequently occurs in concussion, but as soon as consciousness returns full control is regained. Periodic reflex emptying of the bladder, or retention of urine, rarely occurs in concussion, and when present points to some more serious gross lesion. The same may be said of loss of control of the bowel, though its action is largely determined by the state of fullness or emptiness of the rectum at the time of the accident, and by the consistence of its contents.

(h) *Reflexes*. The deep reflexes are usually abolished immediately after a severe head injury, and their state is of little assistance if there be no difference on the two sides. In a case of unilateral intracranial hæmorrhage, the state of the reflexes may be of great value in indicating where to operate, exaggeration of the tendon reflexes with abolition of the abdominal and cremasteric reflexes, and a positive Babinski's sign (extension of the great toe on stroking the sole of the foot) on one side, pointing to pressure upon some part of the pyramidal tract of the opposite side within the skull.

(i) *Pulse*. A slow full pulse of high tension indicates increased

intracranial pressure, and may be of great assistance in distinguishing a case of intracranial hæmorrhage from one of concussion. A pulse of varying tension and irregular in rhythm in a patient with intracranial hæmorrhage, points to the urgent need for relief of the intracranial pressure by operation.

(j) *Respiration*. Usually shallow and regular in concussion, the respiration in compression is deepened and slowed. When it becomes of the Cheyne-Stokes character, the need for relief of pressure by operation becomes imperative.

(k) *Cerebro-spinal fluid*. The fluid withdrawn by lumbar puncture may contain blood. If it does, intradural hæmorrhage is indicated, but beyond this point little information is gained. When the symptoms of cerebral compression are at all severe, the procedure is not devoid of danger, as the removal of the fluid from below may cause a jamming down of the medulla into the foramen magnum, followed by sudden death. Only a few drops of fluid should therefore be removed, in order to examine for the presence of blood.

(l) The *temperature* is usually subnormal in cases of severe head injury, and the surface of the body is pale, cold, and clammy.

It cannot be too strongly insisted upon that a diagnosis based upon a single examination shortly after a head injury is very likely to be erroneous. All cases, even those which at first view appear trivial, should be watched and examined carefully at intervals, until several hours have elapsed, lest a case of progressive intracranial hæmorrhage be overlooked.

#### TREATMENT OF HEAD INJURIES

In degree and extent the individual varieties are endless, but from the point of view of treatment, and especially of immediate treatment, certain main types are to be distinguished, and may be broadly grouped as follows :—

##### 1. *Concussion*

Under this head are included those slighter degrees of contusion and laceration of the brain which do not require operative measures. • Examination conducted on the lines laid down above will exclude the presence of gross injury to the brain, although it must not be forgotten that symptoms due to progressive hæmorrhage may develop later.

The immediate treatment consists in putting the patient into a warm bed, with hot bottles, and awaiting events. If con-

sciousness is not restored in a few hours, and yet there are no such symptoms of increased intracranial pressure as to demand opening the skull, a lumbar puncture may with advantage be performed and some cerebro-spinal fluid allowed to escape. It will often be found to escape freely under pressure, probably indicative of the presence of oedema of the brain, a condition which is not uncommon in concussion and laceration of the brain.

If the pulse indicates a low blood-pressure, the limbs and abdomen may be firmly bandaged, and the head kept low. Cardiac stimulants must be avoided. An ice-bag may be applied to the head. It must not be forgotten that on recovery of consciousness from a severe concussion the patient may, from temporary loss of memory or from the state of excitability which sometimes follows, be irresponsible for his actions, and need restraint; sedative drugs also may be required.

The more severe cases are also sometimes followed by a train of symptoms known as those of *cerebral irritation*. The patient lies curled up in bed, with frowning expression and contracted pupils, and resents being interfered with in any way. He refuses food when it is offered, but will take it at his own time if it is placed beside him. He will pass water into the bed, not because he is incontinent, but because it is too much trouble to use a utensil. This state may last for several days. Prolonged and rigid quietude is demanded, in proportion to the severity of the case.

## 2. *Compound Comminuted Fracture of the Skull, with or without Laceration of the Membranes and Brain*

These cases present no diagnostic difficulty, nor should there be the least hesitation in proceeding at once with operative treatment.

*Operation.* No anæsthetic is required if the patient is unconscious, but if the incision causes struggling a minimal amount of chloroform should be administered. The scalp should be shaved completely, and the skin thoroughly cleansed with soap, nail-brush, and hot water. It is best, in the next place, to turn down a large flap of scalp, including the wound, so as completely to expose the fractured surface. This done, all loose fragments are to be removed, and any depressed but unseparated pieces of bone raised to the level of the surrounding skull. It is particularly important to ascertain that there are no splintered fragments of the inner table left behind. This is done by sweeping a thin flat

instrument for some distance around the bony opening, between the skull and the dura mater. If the dura mater is torn, the wound in it must be exposed in its whole extent by removal of as much bone as may be necessary for that purpose, and any protruding brain-matter may be cut away with scissors. The whole wound must now be cleansed with a copious stream of sterile saline solution at 110° F. No attempt should be made to suture the dura mater. The scalp-flap must next be cleansed, replaced, and sutured, and any dirty bruised edges of the original wound freely cut away.

A large absorbent antiseptic dressing is required, as a considerable amount of exudation is to be expected, particularly if the dura mater has been wounded, when cerebro-spinal fluid may continue to escape for several days. The escape of cerebro-spinal fluid is usually attended by irregular oscillations of temperature, quite apart from any ascertainable signs of bacterial infection. Some bulging of the brain is to be expected from the cedema which so readily follows any cerebral injury. Excessive bulging, with the formation of a fungus cerebri indicates infection, and this is usually, though not necessarily, followed by a fatal termination. Should such a fungus cerebri occur and the patient survive the dangers of septic meningitis, a careful watch must be kept for the formation of a localized abscess of the brain.

### *3. Depressed Fracture without Scalp Wound*

If there is no wound, the diagnosis of depressed fracture is not always easy, especially in the absence of cerebral symptoms. Natural irregularities of the surface of the cranium may give rise to confusion, and a hæmatoma of the scalp (Fig. 81) is sometimes very difficult to distinguish from a depressed fracture (Fig. 82). The soft centre and firm edge of a hæmatoma may make diagnosis by palpation alone impossible, and in such a case the X-rays may be of assistance. Should any doubt remain, the trivial risks of an exploratory incision are to be preferred to the serious dangers of leaving unrelieved a depressed fracture, possibly with spicules of bone penetrating the dura and brain. When symptoms of pressure and of cortical irritation are present immediately after the accident, no surgeon would hesitate to operate, but the same course is, unfortunately, not always pursued when immediate cerebral symptoms are absent. Such neglected cases provide a not inconsiderable proportion of the sufferers from traumatic insanity and focal epilepsy. Few

surgeons of the present day would take exception to the rule that all cases of depressed fracture of the skull, whether causing immediate symptoms or not, should be operated upon. The only exceptions are certain of the obstetrical depressions met with in the heads of the newly born, because the elasticity of the cranial vault in very early life, together with the growth of the bones, may allow spontaneous rectification to occur.

*Operation.* Unless the patient is profoundly unconscious, chloroform is to be administered, and the scalp shaved and cleansed. A flap is turned down so as to expose a large area of

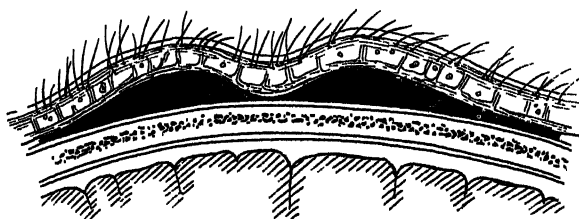


FIG. 81. Hematoma of scalp resembling superficially a depressed fracture.

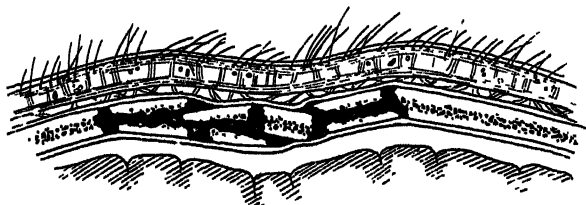


FIG. 82. Depressed fracture of skull.

skull, including the depressed portion. A medium-sized trephine hole is next made close to the edge of the fracture, and through this a flat instrument is introduced between the bone and dura mater, and the depressed bone raised to its normal level. When this has been done the dura mater elevator should be swept round over a considerable area between the bone and dura, to make sure that there are no fragments of bone still remaining. The wound is then closed.

#### 4. *Penetrating Wounds of the Skull*

Such injuries are caused by gunshot wounds, and stabs with knives and other pointed weapons. If the immediate operative treatment of ordinary depressed fractures is necessary, that of

punctured wounds is even more so, because of the added dangers of foreign bodies, splinters of bone, and sepsis.

A disc of bone including the punctured wound should be removed, spicules of the splintered inner table carefully sought for, and the dura or exposed cortex cleansed with a copious stream of hot saline solution. In the case of a gunshot wound, when the bullet remains lodged it should at once be localized by X-ray examination, and, unless lying in an inaccessible position, it should always be removed.

### 5. *Fracture of the Base of the Skull*

Apart from concomitant intracranial injury, basal fractures are of little moment, nor do they require any special treatment beyond the disinfection of the ears and nose and keeping the patient at rest in bed. Most often there is evidence of concussion, laceration, or compression, in addition to the bony lesion, in which case treatment must be directed to the relief of the intracranial complication, as described under Concussion and Intracranial Hæmorrhage.

### 6. *Intracranial Hæmorrhage and Cerebral Compression*

Traumatic hæmorrhage may be extradural, intradural, or, rarely, intracerebral. It may occur with or without fracture of the skull, but is most commonly a complication of fracture. When intracerebral, it may result from a penetrating wound of the skull. The symptoms are those of increased intracranial pressure, with or without focal symptoms.

In the newly born the hæmorrhage is venous, and, according to Harvey Cushing, is probably derived from tributaries of the great venous sinuses which are torn by the moulding of the head during labour. Such an injury is evidenced soon after birth by cyanosis, irregular respiration and asphyxia, a tense, non-pulsating fontanelle, and perhaps by convulsions; in later life, if recovery ensues, by some degree of spastic paralysis.

In adult life the bleeding is usually arterial, and may proceed from any meningeal vessel torn with the dura in fracture of the skull, but when severe enough to cause a rapidly deepening coma, the vessel injured is most commonly the middle meningeal artery or its anterior branch. The fundamental symptoms of meningeal hæmorrhage are convulsions of the contra-lateral limbs, followed by deepening coma and hemiplegia. The injury, however, may produce an initial concussion, of greater or lesser

degree, with its own train of symptoms. These may be in part recovered from, and then, with increasing hæmorrhage, spasms appear, first of the opposite side of the face and then of the arm; more rarely the convulsions are general. Between the spasms the affected limbs may be rigid, but with deepening coma they become flaccid.

The pupil on the side of the hæmorrhage, at first contracted, gradually becomes dilated and stabile, followed by similar changes in the pupil of the opposite side. Too much reliance, however, must not be placed upon the state of the pupils, which is apt to be very variable. The pulse becomes full and gradually more slow, until the final phase, when it is irregular; respiration also becomes very irregular, both phenomena being due to increasing disturbance of the medullary centres. The blood-pressure rises rapidly until the terminal phase. According to Cushing, œdema of the optic discs soon begins to appear.

The question of operation may be one of great difficulty. In the cases with rapidly deepening coma, as when a large meningeal artery has been torn, the line of action is clear; but in the slighter degrees the surgeon's duty is not so obvious, inasmuch as it is well known that many such cases recover, or at least survive. Cushing, to whose work we owe much of the present knowledge of the conditions and consequences of intracranial hæmorrhage, is of opinion that if more operations were done in the less severe cases for the relief of pressure and the removal of blood-clot, there would be fewer of the late complications seen, whether epileptic, paralytic, or neurasthenic.

*Operation for middle meningeal hæmorrhage.* A flap of scalp is turned down, with its centre corresponding to a point an inch and a half behind the external angular process, and the same distance above the zygoma. At this spot a disc of bone is removed with a medium-sized trephine, and the aperture enlarged as much as may be necessary by means of skull-cutting forceps. This classical opening in the skull does not always expose the artery, as in the case figured (Fig. 83), in which the vessel lies farther back than usual. This small abnormality, however, is of little moment as the customary trephine opening is much too small for any effectual intracranial manipulation, and should always be freely enlarged.

The artery should either be ligatured in the ordinary manner or it must be secured by means of a stitch passed through the dura mater upon which it lies. If it should be contained in a bony canal at this point, the canal should be plugged with



aseptic wax. Any clot lying between the bone and dura mater is now removed by means of a blunt spoon under a stream of sterile saline solution at a temperature of 110° F., and the wound closed.

*Operation for hæmorrhage in fracture of the base of the skull.* Many cases of fracture of the base of the skull recover spontaneously, though probably many of the later sequelæ could be avoided by timely operation. Some, on the other hand, are clearly

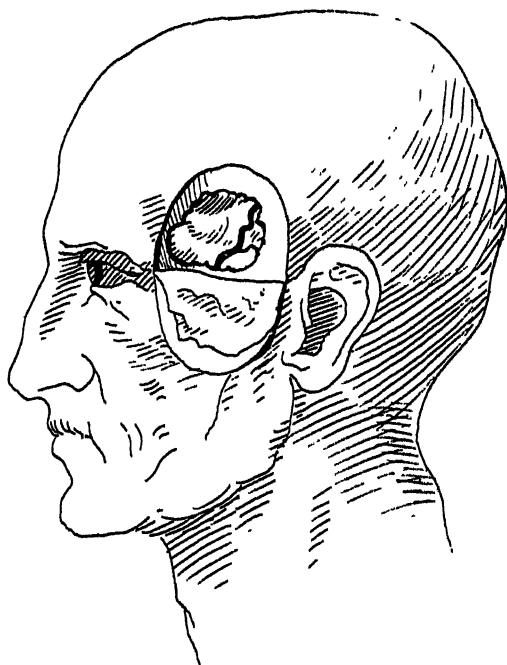


FIG. 83. Exposure of middle meningeal artery.

hopeless from the outset, on account of the severity of the cerebral injury, or because of concomitant injuries and other factors. Between these two classes there is a certain number of cases of moderate severity in which unconsciousness is prolonged for several days, and in which the patient is obviously suffering from cerebral compression from which he either eventually dies, or recovers with permanent damage to the brain. These are the cases in which an operation for the relief of the intracranial tension is indicated, and for this purpose the best procedure is the *subtemporal decompressive operation* devised by Cushing.

It is not an operation of which the difficulties need deter any one accustomed to surgical procedures, and under suitable conditions, from undertaking.

The head having been shaved and cleansed, an incision is made so as to mark out a flap covering the whole temporal fossa, and with its base upon the zygoma. The flap, consisting of skin and temporal fascia, is turned down, and the temporal muscle split in the direction of its fibres and elevated from the underlying bone, but without disturbing any of its peripheral attachments. The muscle being well retracted, a trephine opening is made, and enlarged with bone-cutting forceps until the bone has been removed as extensively as possible from beneath the muscle. If the blood and clot is extradural, it should be washed away with a stream of hot saline solution and any accessible bleeding-point secured; if the tenseness of the dura indicates that the compression is due to intradural hæmorrhage, the dura mater must be opened also. The muscle is then allowed to slip back into place, and the flap sutured.

The opening permits of the escape of the compressing blood into the submuscular tissue, whilst the temporal muscle serves to control the temporary hernia cerebri which forms after the operation.

## II. INJURIES OF THE SPINE

The chief importance of any injury to the spine lies in the presence or absence of damage to the cord and nerve-roots. Many minor and some major injuries of the spine, such as laceration of muscles, fascia, or ligaments, as well as partial fractures and slight degrees of dislocation, particularly those of the unilateral type in the cervical region, occur without damage to the cord. According to the figures collected by Donald Armour, the spinal cord escapes in one-third of the cases of injury affecting the vertebral column. On the other hand, severe damage to the cord may occur without obvious signs of gross injury to the vertebral column.

Concussion of the cord, though a rare condition, undoubtedly occurs. Some of the cases diagnosed as such are probably instances of damage done by momentary displacement of the bones upon one another, such as occurs in the cervical region, and others may be examples of slight degrees of hæmorrhage into the cord (hæmatomyelia). Yet again, genuinely 'functional' symptoms may follow slight injuries to the spine. But there remain a certain number of cases which can only be regarded as concussion

comparable to that which so frequently happens in the case of the brain. The following case illustrates this well : the patient, himself a medical man, in diving from a height into shallow water, struck his head against the muddy bottom of the river, causing a violent extension of the neck. When removed from the water he was completely paralysed and anæsthetic from the level of the fifth cervical segment downwards. There was no loss of consciousness. After a few minutes, sensation began to return, accompanied by tingling, and shortly afterwards he could move his legs. Complete recovery rapidly ensued.

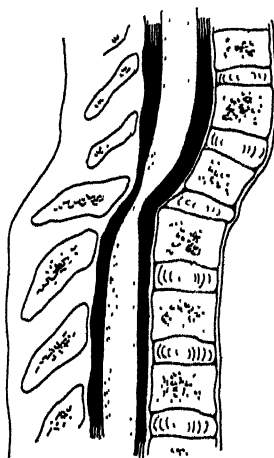


FIG. 84. Fracture dislocation of the spine.

Blows and falls upon the back provide a certain number of examples of injury to the spinal cord, as also do stabs and bullet wounds, but the more common, and usually the more severe instances, occur from violent flexion or extension of the trunk. The commonest form of displacement is that shown diagrammatically in Fig. 84, in which the upper portion of the vertebral column slides forward upon the lower. Such an accident may cause any degree of injury to the cord up to complete severance within the theca. The cord may also be damaged in fracture dislocation of the spine by the pressure of fragments of detached bone, or by being stretched over the sharp angle of bone produced in displacements. Hæmorrhage, either extrathecal, intrathecal, or into the substance of the cord, may also cause pressure symptoms. When the lumbar spine is involved the nerves of the cauda equina may be injured.

## EXAMINATION IN CASES OF SPINAL INJURY

If the patient is seen immediately after the accident he will usually be found to be in a collapsed condition, and so long as this state persists the nervous symptoms are apt to be misleading. The shock should be treated only by warmth in bed and morphia, stimulants being withheld in view of the possibility of hæmorrhage. When the immediate shock has passed off a careful examination should be made :—

- (a) Of the spinal column.
- (b) Of the cord symptoms.
- (c) To ascertain whether any other injuries are present.

(a) *The spinal column.* Rigidity, pain, local tenderness, and ecchymosis are first to be looked for. In a muscular man it is sometimes difficult to detect even a gross displacement of the vertebræ. Any irregularity of the spinous processes, especially if accompanied by cord symptoms of even the slightest degree, should be looked upon with suspicion, remembering, however, that a spinous process or a lamina may be fractured without any interruption of the continuity of the vertebral column. The absence, however, of any break in the continuity of the spinal column does not exclude the possibility of gross injury to the cord, because it is believed that, in the cervical region especially, a dislocation can occur and become reduced by the time that the examination is made. A fracture through a single lamina may be sufficient to cause a hæmorrhage large enough to produce symptoms of pressure upon the cord. Whenever possible an X-ray examination should be made.

(b) *The spinal cord.* It is rarely possible to come to a definite conclusion as to the nature or extent of the injury to the cord immediately after the accident, and usually it is necessary to watch the case most carefully from hour to hour, in order to observe whether the signs of damage increase or decrease. It is upon the *persistence* or *alteration* of the cord symptoms rather than upon their actual presence at the outset, that a correct diagnosis has to be based. Part of the loss of conductivity of the cord may be physiological and not anatomical, and it is impossible at first to say how much may be recovered from.

The details of the symptoms vary, of course, with the level of the injury, and need not be entered into here; the symptoms common to injuries at any level may be broadly classified according to whether the injury is a complete or an incomplete

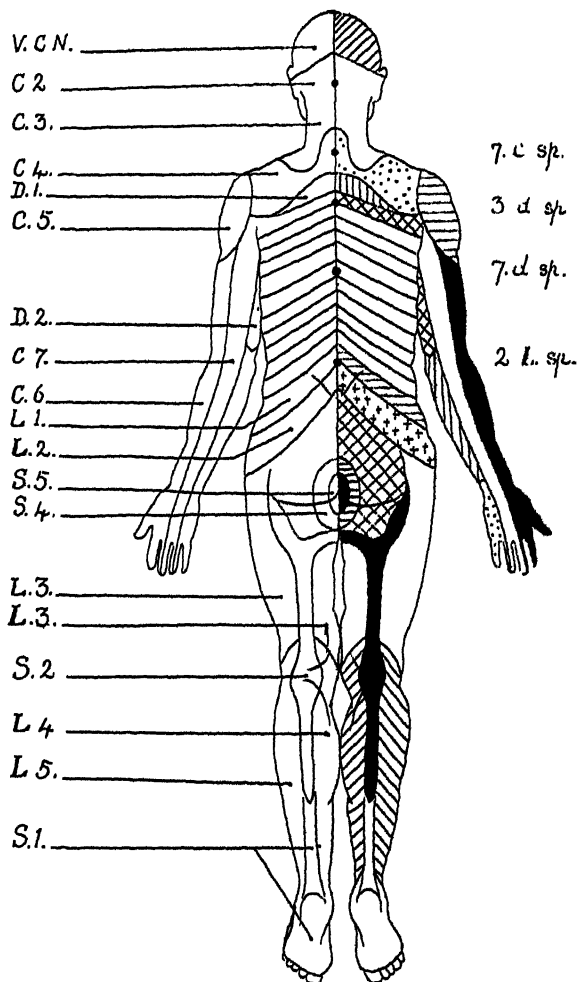


FIG. 85. Segmental areas as given by Aldron Turner and Grainger Stewart.

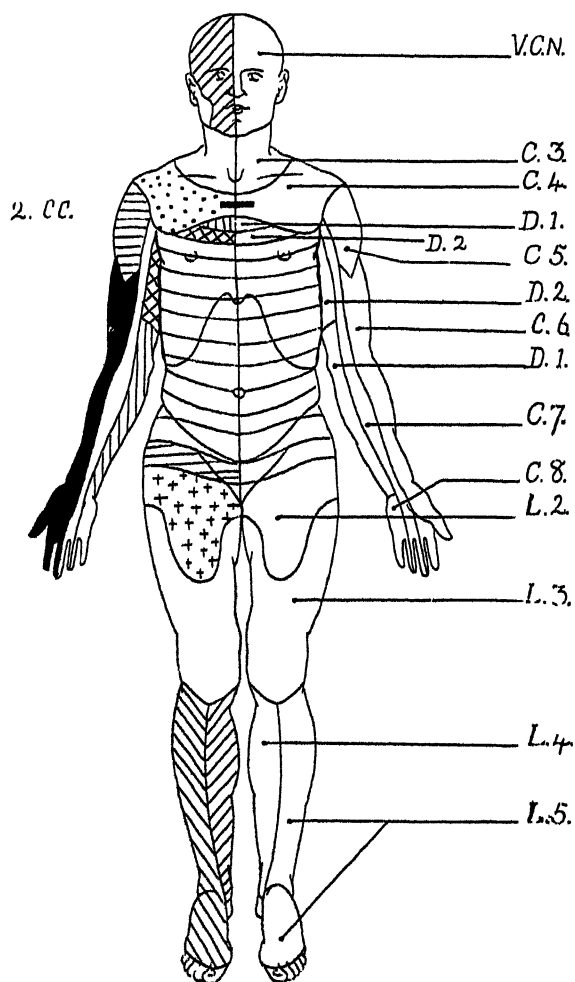


FIG. 86. Segmental areas as given by Aldren Turner and Grainger Stewart.

transverse lesion of the cord. If the injury involves the spine at or below the level of the first lumbar vertebra, where the cord ends, the only nerve structures damaged will be those of the cauda equina, and the symptoms will then depend upon what particular lumbar or sacral nerve-roots happen to have been damaged. In the area of distribution of those roots there will be pain and loss of sensation, with paralysis and subsequent wasting of muscles. The segmental areas of altered sensibility are shown in Figs. 85 and 86.

(i) *Symptoms of a complete transverse lesion of the cord.* These are flaccid paralysis of all muscles below the site of the injury, together with total loss of all forms of sensibility; loss of sphincter control; and loss of the deep reflexes. A sluggish plantar extensor reflex is not uncommon. If these symptoms are present immediately after the injury, and persist for many hours without alteration, the probability is that the cord has been completely crushed or divided, and that the case is hopeless.

(ii) *Symptoms of partial transverse lesion of the cord.* There may from the outset be evidence that the conductivity of the cord is not completely interrupted; or a case which at first presents symptoms of a complete transverse lesion may show signs of recovery up to a certain point. On the other hand, the reverse may hold good; a case presenting symptoms of incomplete transverse lesion may, after an interval, present the signs of a complete one. In such cases the probability of hæmorrhage is considerable, and the indication for operation becomes clear. The symptoms which indicate an incomplete transverse lesion are naturally very variable, but, generally speaking, they are weakness of muscles, probably of differing degree on the two sides; alteration of sensation, such as diminution of sensibility to pain (pin-prick) and to touch (cotton-wool); alteration of reflexes, such as exaggeration of knee-jerk, an extensor plantar reflex and loss of abdominal reflex; and loss of control over the sphincters of varying degree.

(c) *Concomitant injuries.* So severe is the violence necessary to cause grave spinal injuries that other serious lesions may co-exist, such as fractures of the ribs or pelvis with laceration of the thoracic or abdominal viscera. The presence of any such concomitant injury would modify the line of treatment, and might at once contra-indicate any operation upon the spine.

## THE QUESTION OF OPERATION IN SPINAL INJURIES

There still exist very wide differences of opinion with regard to operations for fracture-dislocation of the spine. No doubt some are deterred from operating by lack of acquaintance with the special surgery of the spine; others by the disappointing results that are often obtained; and others, again, by the idea that the necessary manipulations may actually increase the damage to the cord. Some wait for days or even weeks, in the vain hope that improvement may ensue, and only operate as a last resort when the time for effective action has been allowed to slip by.

Even by one unfamiliar with the special technique of spinal operations, laminectomy for relief of pressure upon the cord may have to be undertaken. The risks of an exploratory laminectomy are small compared with those of procrastination. In judging of the suitability of any given case for operation the following general rules may be of service :—

1. In some cases the contra-indications to operation are clear and decisive. These are, (a) such a position of the upper and lower portions of the vertebral column with relation to one another as to make it obvious that the cord must have been completely divided, and (b) serious concomitant injuries or such a general condition as to make it clear that death must result.

2. If there is no evidence whatever of conduction in the cord, and this condition persists whilst the patient is under frequent and careful observation for many hours, it is probably useless to operate. But even under these circumstances some surgeons would not shrink from an exploration of the spinal canal, recognizing the impossibility of making a sure diagnosis without such exploration, and knowing that delay will finally abolish any chance of recovery (should the cord symptoms be due to compression by blood or displaced fragments of bone) if operation should be undertaken later.

3. If the symptoms are those of an incomplete lesion, and improvement does not take place very rapidly, operation should be undertaken. This is especially necessary when deformity is still present.

4. If after two or three hours' observation the cord symptoms, so far from clearing up, become progressively more marked, the probability is that hæmorrhage is in progress, and there is then no excuse for delaying operation.



The objects aimed at in operating upon these cases are precisely the same as in the case of cranial injuries, namely, to relieve the nerve elements from pressure by displaced bone, remove detached fragments of bone, clear away blood-clot, arrest hæmorrhage, and so to place the cord in the best possible circumstances for such recovery as is possible to take place.

*Operation.* The mere reduction of a displacement by traction and manipulation is not to be recommended. It is unreliable as a means of relieving pressure upon the cord, is not devoid of

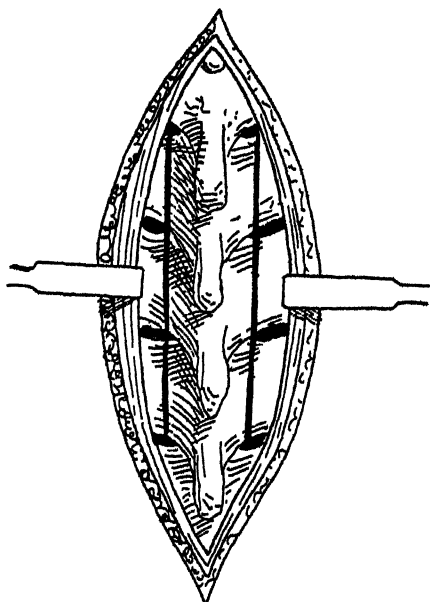


FIG. 87. Laminectomy.

danger, and would avail nothing if the pressure were due to hæmorrhage or to a detached fragment of bone.

The operation which should be carried out is as follows: the patient is anæsthetized with chloroform and placed upon the right side, semi-prone. A long incision is made with its centre corresponding to the site of injury, over the spinous processes, and the posterior aspect of the neural arches freely exposed by separation and retraction of the dorsal muscles (Fig. 87). The laminae are then partially sawn through near the articular processes, and the division is completed with bone-cutting forceps.

The removal of several neural arches is necessary, in order to

give a thorough exposure of the spinal canal, and to enable any blood-clot and loose fragments of bone to be removed. It is essential that the utmost gentleness should be exercised throughout; on no account must the theca or cord be touched with fingers or swabs. A stream of hot saline solution at 115° F. should be allowed to run over the wound during the operation; this makes swabbing unnecessary, keeps the parts from becoming chilled, and acts as a hæmostatic. If the theca is distended with blood, it should be opened by a median vertical incision, and the clot gently washed away with the stream of hot saline. When this is done there is no necessity to suture the theca afterwards. The wound is then closed, an abundant antiseptic dressing applied, and the patient placed flat upon the back upon a water-bed.

The *after-treatment* consists chiefly of efforts to prevent the formation of bed-sores; the regular use of the catheter when necessary, every effort being made to prevent cystitis; and daily massage and electrical treatment of the paralysed muscles. So frequently does cystitis occur in spite of the utmost care, and even in the absence of catheterization, that suprapubic drainage has been advocated as a routine measure to prevent this dangerous complication.

### III. INJURIES OF PERIPHERAL NERVES

A peripheral nerve-trunk may be completely divided in an incised wound, as so frequently happens in the case of the median and ulnar nerves at the wrist; it may have its conductivity only partially interfered with by contusion, laceration, bullet wounds, and incised wounds which do not completely divide it; or there may be physiological interference with function due to the pressure of displaced fragments of bone in fractures.

The *diagnosis* of injury to a nerve-trunk rests upon (a) paralysis of the muscles supplied by it, and (b) loss of *cutaneous* sensibility to pain (pin-prick), touch (cotton-wool), and heat and cold.

*Treatment.* When the nerve is completely divided there should be neither doubt nor delay as to the line of treatment, namely immediate suture. The promptness with which this is undertaken makes a considerable difference in the prospect of recovery.

In the case of contusion, laceration, and partial division considerable difficulties may arise. The exact nature and extent of the injury may be difficult to determine, and it may be doubtful whether operation affords any prospect of improving the

condition; moreover, the nerve at the point of injury may be inaccessible. It should not, however, be assumed that because there is evidence of partial conductivity in the nerves the prospect of recovery cannot be improved by operation. A large nerve-trunk may be partly divided by a stab or bullet wound, and the divided portion may be capable of suture. On the other hand, the nerve may have been perforated by a bullet, or otherwise damaged in such a manner as to cause no breach in its anatomical continuity, and so present a condition which operation would not benefit.

When the injury is due to pressure from displaced fragments of bone, immediate operation is imperative, because it is certain that an interference of conductivity which is at first only physiological will very rapidly become permanent from degenerative changes. We have seen a case of a depressed fragment of a broken clavicle pressing upon the lower cord of the brachia plexus; it was removed within a few hours of the accident, and recovery rapidly followed.

It may, therefore, be laid down as a rule that in every case of complete division of a nerve-trunk, suture should be performed as soon as possible after the injury; and that in cases of partial division exploration should be undertaken and the case dealt with according to the condition found. If the continuity of the nerve-trunk as a whole is found to be uninterrupted, nothing further should be done. If, however, the trunk is partly divided, this portion should be sutured without interference with the rest of the nerve.

#### *Suture of a Divided Nerve : Operation.*

Inasmuch as primary union is of the utmost importance in these cases, the greatest possible attention must be paid to cleansing the wound and securing asepsis. On no account should strong chemicals be brought into contact with the injured nerve, and as weak ones are valueless it is better to avoid their use altogether. The ends of the divided nerve having been found, for which purpose it is usually necessary to enlarge the wound, they should be accurately approximated with one or two sutures of fine silk carried on a round-bodied needle, and passed through the whole thickness of the nerve about a quarter of an inch from the cut surface. In the case of a large or medium-sized nerve, a number of fine silk sutures should be passed through the sheath (Fig. 88), so as to approximate accurately its cut edges all round, care being taken not to invert the sheath between the

cut nerve bundles, nor to permit those bundles to protrude, as they are rather apt to do. The wound having been closed, the limb is fixed by suitable splints in such a position as to secure

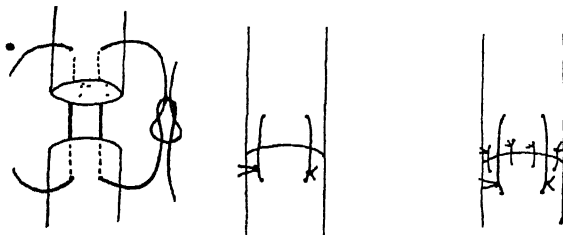


FIG. 88. Three stages in the suture of a nerve.

relaxation of the sutured nerve, and this position should be maintained for ten days or a fortnight. The after-treatment consists of persistent massage and electrical treatment of the muscles supplied by the injured nerve.

## CHAPTER XIX

### DISEASES OF THE NERVOUS SYSTEM

#### I. UNCONSCIOUSNESS

A common and serious emergency in practice, both as regards causation and treatment, is the condition of unconsciousness. It is frequently of rapid or sudden onset, and may be the first symptom to draw attention to the existence of unsuspected disease.

In many cases previous knowledge will at once indicate the probable cause of the coma; for example, the patient may be known to be suffering from diabetes, cerebral tumour, or chronic renal disease. But previous knowledge of a patient does not render careful examination unnecessary; for instance, coma in an epileptic or an alcoholic may be due to cerebral injury following a fall.

In the following description we will consider the method of investigation in the case of a patient found unconscious, with special reference to those cases in which little or no further information is available, as such cases not infrequently involve medico-legal questions, so that a careful consideration of all the accompanying circumstances is of great importance.

The common causes of unconsciousness are cranial injury; cerebral hæmorrhage, thrombosis, and embolism; diabetes; epilepsy; uræmia; certain poisons (particularly alcohol and opium); syncope and sunstroke.

#### METHOD OF INVESTIGATION OF AN UNCONSCIOUS PATIENT

1. *History.* If available, this is often of the greatest help. The patient may be known to be an epileptic, or to be suffering from diabetes, or to have complained of headache, or to have had transient hemiplegia or aphasia on a previous occasion. The method of onset of unconsciousness should be ascertained, whether gradual as in diabetic coma, or sudden as in cerebral hæmorrhage.

Sometimes, however, no account whatever is forthcoming, and the diagnosis has to be made from physical examination alone.

2. *Signs of injury.* These must be carefully sought for (see p. 337).

3. *General appearance of the patient.* The build and general appearance of the patient should be noted. A stout, full-blooded individual, with suffused face and stertorous breathing, suggests cerebral hæmorrhage. Emaciation, on the other hand, points rather to a wasting disease such as diabetes. A bitten tongue suggests epilepsy.

4. *The degree of coma.* This may be estimated by ascertaining whether there is any response at all to such stimuli as shouting and pinching, or to a pungent odour like ammonia.

5. *Respiration.* This may be noisy or stertorous, as in cerebral hæmorrhage; slow, almost inaudible breathing occurs in opium poisoning: slow, feeble, and often irregular respiration occurs in syncope; deep sighing respirations in diabetic coma.

6. *The breath.* The smell of alcohol is readily detectable, but it cannot be too strongly insisted upon that the greatest caution must be exercised as regards this, as brandy is nearly always poured into an unconscious patient's mouth before the arrival of the medical man. Again, laudanum, taken with suicidal intent, may be taken in a glass of stout; the smell of laudanum can usually be readily recognized. Acetone has a very characteristic odour, and immediately suggests diabetic coma. In uræmia the breath has often a distinctive urinous odour.

7. *The circulatory system.* In cerebral hæmorrhage the pulse is often full and hard, and is apt to be somewhat slower than normal. The apex beat is often displaced outwards from hypertrophy of the left ventricle, and the aortic second sound is ringing in character. In apoplexy due to thrombosis in an atheromatous artery, the pulse is much feebler, and the heart sounds fainter, with no accentuation of the aortic second sound. The presence of the murmurs of mitral stenosis or of aortic disease suggests cerebral embolism. The pulse is of high tension in chronic renal disease. The syncopal attack of the Stokes-Adams syndrome may be recognized from the extreme slowness of the pulse, which may be as low as twenty per minute or even lower. In a fainting attack the pulse is very feeble, and sometimes almost imperceptible.

8. *The temperature.* In the majority of cases the temperature does not afford any help; it is usually subnormal. In pontine hæmorrhage, however, the temperature is commonly very high, and this is a valuable sign in distinguishing this condition from opium poisoning. Hyperpyrexia also occurs in heat-stroke.

9. *Hemiplegia.* This affords the most important evidence of focal cerebral disease. The arm and leg on the hemiplegic side fall more 'dead' than do those of the unaffected side when lifted up and allowed to drop. The face is asymmetrical, especially in its lower half, the paralysed cheek flaps loosely with respiration, and the mouth is drawn towards the healthy side. On the other hand, rigidity of the limbs is sometimes present on the hemiplegic side.

The common causes of hemiplegia are hæmorrhage, thrombosis, and embolism. In arriving at a decision as to which of these factors is responsible, the age of the patient affords some help. In the child sudden hemiplegia is commonly embolic in origin; in the young adult it is usually due to syphilitic endarteritis; in the older subject to cerebral hæmorrhage or thrombosis. Syphilitic endarteritis and atheromatous disease frequently give rise to premonitory attacks of transient aphasia or hemiplegia, or numbness and tingling, antecedent to the apoplectic attack. The onset is not so sudden or severe as in hæmorrhage, unconsciousness is less marked, and may even be absent.

10. *The reflexes.* Both superficial and deep reflexes are abolished in deep coma. In less profound cases, Babinski's sign (viz. an extensor, instead of a flexor movement of the toes, especially of the big toe, on stroking the sole of the foot) is obtained on the hemiplegic side. The deep reflexes, such as the knee-jerk, vary with the depth of the coma. In deep epileptic coma the knee-jerks are abolished, but subsequently they become brisker than normal. On the whole, the reflexes are not very helpful in arriving at a diagnosis.

11. *The eyes.* (a) *Pupils.* Bilateral dilatation is common. It occurs in the coma following an epileptic fit, in uræmia, and in general cerebral compression. It is the commonest condition of the pupil in profound coma.

Bilateral constriction occurs in opium poisoning and in pontine hæmorrhage.

Inequality of the pupils suggests some unilateral lesion.

(b) *The presence of squint.* This strongly suggests the presence of local intracranial mischief, such as meningitis.

(c) *Conjugate deviation.* This also points to a local cerebral lesion. In a cortical lesion, such as thrombosis or hæmorrhage with hemiplegia, the deviation of head and eyes is towards the paralysed side, especially if convulsions are present. In hemiplegia from hæmorrhage into the internal capsule, the deviation is towards the unaffected side of the body.

(d) *The fundus oculi.* Optic neuritis is conclusive as to the presence of gross intracranial disease, or of uræmia. Examination should also be made for the bright white spots in the macular region which are characteristic of renal disease.

12. *The ears.* The presence of otitis media would suggest the possibility of an intracranial abscess or of meningitis; or blood may be found in the meatus, pointing to the possibility of fracture of the base of the skull.

13. *The urine.* The presence of sugar suggests diabetic coma; this may usually be confirmed by the presence of diacetic acid, demonstrated by the claret colour produced on the addition of ferric chloride to the urine. The presence of albumen is not conclusive evidence of uræmia; it is frequently present in cerebral hæmorrhage as the result of arteriosclerosis, and transient albuminuria is common after an epileptic fit. A large amount of albumen, however, especially if associated with blood and casts, is indicative of nephritis.

14. *The stomach contents.* In obscure cases it is wise to wash out the stomach and preserve the contents. This is important in view of the possibility of poisoning.

15. *Signs of poisoning.* The mouth and lips may show signs of poisoning, such as bleaching of the mucous membrane by carbolic acid, strong ammonia, caustic alkali, and mineral acids.

The lips are usually a bright red colour in carbon monoxide poisoning. Attention must be paid to accompanying circumstances; the patient may have been sleeping in a room with a faulty slow combustion stove, for instance. Carbon dioxide may be the poisonous gas; such is found in coal-mines from the gas generated by explosions, or in the neighbourhood of limekilns and brick-kilns. In the unconsciousness produced by going down wells, Haldane has shown that loss of oxygen is the factor producing the symptoms, not excess of carbon dioxide.

16. *The cerebro-spinal fluid.* The examination of the cerebro-spinal fluid may be of great assistance. The operation of lumbar puncture is performed as follows (Fig. 2): the patient lies upon his side, with the hips and trunk flexed as much as possible. A convenient position for entering the spinal canal is between the fourth and fifth lumbar vertebræ, and this is indicated by a line drawn between the highest points of the iliac crests. The skin is thoroughly cleansed, and a long, stout, sterilized needle, such as belongs to an ordinary antitoxin syringe, is inserted in this line, half an inch from the mid-line of the body, and thrust inwards. A vertebral lamina is usually encountered, but by



altering the position of the needle so that it points in an upward, forward, and inward direction, the space between the laminæ will be found, and the needle can be pushed into the spinal canal. As soon as the theca is penetrated, cerebro-spinal fluid escapes, and should be received into a sterile test-tube, so that it may, if required, be examined bacteriologically.

A blood-stained fluid may be obtained in fracture of the skull, and frequently in ordinary cerebral hæmorrhage. In meningitis the fluid may be turbid or purulent.

After centrifugalizing, the fluid may be examined for the presence, for instance, of the diplococcus intracellularis, or a cytological examination made of the leucocytes.

### *Treatment*

If a careful examination be made on the preceding lines, an accurate diagnosis may be arrived at in the majority of cases. Only the immediate treatment will be considered.

The treatment of the various injuries of the head is described in Chapter XVIII, and of uræmic coma at p. 326.

## 1. CEREBRAL HÆMORRHAGE

The patient should be placed in bed with the shoulders slightly raised. A pillow should not be placed under the head, for if it is sharply bent towards the chest the breathing becomes stertorous from the pharynx being partly obstructed by the tongue. An ice-bag may be placed on the side of the head and hot-water bottles applied to the extremities. As the patient is unconscious great care should be taken with hot applications lest a burn be produced. Similarly the skin should be kept clean and dry as a precaution against bed-sores; the liability to this complication is much lessened by the use of a water-bed.

As the blood-pressure is usually raised, measures are commonly taken to lower it. Inasmuch as increase of intracranial tension is accompanied by a compensatory increase of blood-pressure which maintains the cerebral blood-flow despite the increased pressure within the cranium, it might seem at first sight that to lower the blood-pressure would be injudicious, but the good results that occasionally follow venesection are incontestable. Venesection may be performed in the full-blooded individual with a strong pulse; about ten ounces of blood should be withdrawn. The lowering of blood-pressure produced by bleeding is very transient, and the good effects are probably to be attributed rather to the

relief of the intracranial pressure by the draining away of blood from the distended cerebral veins and sinuses. It is specially indicated in cases of high arterial tension with a failing heart, distended right auricle, and engorged cervical veins. It must be remembered that in many cases it is impossible to arrive at a diagnosis between hæmorrhage and thrombosis. If in doubt venesection should on no account be performed. Purgation is advisable, and five grains of calomel or a minim of croton oil may be placed on the back of the tongue. The catheter should be used regularly.

It is not necessary to give any food for the first twenty-four hours ; afterwards milk may be given by the mouth if the patient can swallow ; or rectal feeding may have to be employed.

During the febrile reactionary period the bowels should be kept well open and stimulants avoided.

## 2. CEREBRAL THROMBOSIS

(a) *Syphilitic*. Active mercurial treatment is indicated, and one of the most suitable methods is daily inunction with a drachm of mercurial ointment. Twenty grains of potassium iodide should be given three times daily as soon as the patient can swallow. Complete recovery cannot be expected, as a certain amount of softening must occur, but there is probably a zone of brain tissue surrounding the central area which is capable of recovery, and this may be favourably influenced by treatment. Further, other vessels may be grossly affected, and active treatment will restore their patency and diminish the possibility of further thrombosis (see also p. 382).

(b) *Atheromatous*. This commonly occurs in elderly feeble subjects, and the initial shock produced by the apoplexy so impairs the force of the circulation as to tend to promote extension of the thrombosis. The circulation must therefore be stimulated. A dose of ammonia and ether may be given ; the patient should be warmly wrapped up, and hot-water bottles applied. The use of strong purgatives is inadvisable, but constipation should be prevented.

## • 3. CEREBRAL EMBOLISM

Nothing can be done either in the direction of treatment of the embolism and its resultant softening or of preventing further embolisms. The patient should be kept in bed, and attention paid to feeding him and avoiding bed-sores.

#### 4. DIABETIC COMA

Diabetic coma may come on very rapidly and without any premonitory symptoms, or it may follow over-exertion. Sometimes its onset is heralded by nausea and vomiting. Diacetic acid is always present in the urine.

*Treatment.* With the view of attempting to ward off the onset of coma in cases of diabetes in which the urine gives the red diacetic acid reaction with ferric chloride, alkaline treatment should be adopted. A drachm of bicarbonate of soda should be given three times a day and the bowels kept well open. When coma supervenes the prognosis is extremely bad, but temporary improvement has followed the use of intravenous injection of three or four pints of a three per cent solution of bicarbonate of soda. Inhalations of oxygen should also be tried.

#### 5. SUNSTROKE

Exposure to excessive heat may give rise to serious symptoms. Alcoholism, exhaustion, and bad ventilation greatly increase the liability to an attack.

(a) *Heat exhaustion.* Giddiness, nausea, and syncope are the main symptoms. The patient should be placed in as cool a place as possible. Cold water may be sprinkled on the head and chest, and ammonia and other stimulants given.

(b) *Heat stroke.* This may be very rapid or even sudden in onset. It is characterized by coma and hyperpyrexia. The patient should be placed, if possible, in a cold bath, and ice added. If a bath is not available he should be wrapped in a sheet wrung out of cold water and ice laid on it. An ice-bag should be applied to the head. The rectal temperature should be taken every two or three minutes, and as soon as the temperature is clearly falling the ice applications should be stopped, as otherwise dangerous collapse may follow. Venesection should not be performed. Stimulants may be necessary.

Subsequently hypnotics are often required for insomnia, headache, and irritability.

### II. CONVULSIONS

*Diagnosis.* It is very important to arrive at an exact diagnosis of the cause of a convulsive fit, not necessarily that the immediate treatment of the attack will be affected, but because the subsequent treatment differs so widely.

Consciousness is commonly lost in a convulsion, but in local cerebral disease with unilateral convulsion consciousness may either be retained throughout the whole fit, or only lost in the later stage with generalization of the convulsions. Consciousness is also retained during the spasms of strychnine poisoning, of tetanus, and of hydrophobia.

## 1. EPILEPSY

A long history of recurrent fits is strong evidence that they are epileptic in nature. When of recent development they have to be distinguished from those resulting from gross cerebral disease, from uræmia, and from other conditions mentioned below.

*Treatment.* (a) *Epileptic fit.* The patient may have fallen in an awkward position. He should be placed flat on the floor or bed, and his collar should be loosened so that there may be no obstruction to breathing. Something should be inserted between his teeth to prevent tongue-biting. If vomiting occurs at the end of an attack the patient should be placed on his side to minimize the risk of some of the stomach contents finding their way into the larynx and trachea. If a second fit occurs, an inhalation of amyl nitrite or a little chloroform may be given. Amyl nitrite, given in the aural stage, will sometimes prevent the further development of the attack. Finally, the patient should not be awakened after the attack, as severe headache often follows a fit, and if he sleeps for several hours it will often have passed off by the time of waking.

(b) *Status epilepticus.* If the fits are frequent the patient should be put under the influence of chloroform. Thirty grains of chloral may at the same time be injected into the rectum and if necessary two or three such injections may be given at hourly intervals. Numerous cases have been reported in which cure has followed the withdrawal of cerebro-spinal fluid by lumbar puncture. This should be done, the patient being chloroformed to facilitate the operation. One hundredth of a grain of hydrobromate of hyosine may also be injected subcutaneously.

## 2. HYSTERICAL FITS

The fact that some hysterical fits are really post-epileptic phenomena makes their careful study a matter of importance. The main distinctions between epileptic and hysterical fits are summarized in the following table (from Gowers) :—

## DIAGNOSTIC CHARACTERS OF EPILEPTIC AND HYSTERICAL FITS

	<i>Epileptic.</i>	<i>Hysterical.</i>
Exciting Cause	Rare.	Often emotional disturbance.
Warning	Any, but especially special senses, unilateral or epigastric aura.	Palpitation, malaise, choking.
Onset	Sudden.	Sometimes gradual.
Scream	At onset, strange in sound.	During course, quasi-volitional.
Convulsion	Rigidity, followed by 'jerk-ing', rarely rigidity alone.	Rigidity or 'struggling', throwing limbs and head about, fighting, kicking.
Biting	Tongue.	Lips, hands, or sometimes other people and things.
Micturition	Frequent.	Never.
Defecation	Occasional.	Never.
Talking	Never.	Occasional.
Duration	A few minutes.	Often half an hour or longer.
Restraint	To prevent accident.	To control violence.

In the epileptic fit consciousness is absolutely abolished, but this often holds good for the hysterical fit. At the same time great care should be exercised in what is said before an hysterical patient, as it may be remembered afterwards. The epileptic fit usually ends gradually, the patient recovering in an exhausted lethargic condition or the fit passes into the post-epileptic sleep. In hysteria the fit may come to an end abruptly, especially under treatment.

When hysterical attacks are associated with genuine epilepsy, it is more commonly of the minor type. Investigation should be made as to whether a sudden fall and momentary stillness occur before the violent movements begin; this would suggest the presence of petit mal, and the existence of minor seizures apart from the hysterical attack would be conclusive evidence. The post-epileptic attack is also usually much shorter than the ordinary hysterical fit. The general management would be very different in the two cases.

*Treatment.* Active restraint should be avoided as much as possible, as it is very apt to increase the violence of the attack. Hysterical patients hardly ever injure themselves. Pressure on sensitive spots, such as the supra-orbital nerves, will sometimes cut an attack short, and a strong faradic current is often effectual. An injection of a sixth of a grain of apomorphine is the most effectual remedy of all; with the onset of nausea and vomiting the attack ceases.

## 3. INFANTILE CONVULSIONS

These may occur :—

(i) At the onset of acute diseases such as measles, scarlet fever, and pneumonia.

(ii) In the asphyxia associated with severe paroxysms of whooping-cough.

(iii) In gross disease of the brain, such as tuberculous meningitis.

(iv) From reflex irritation such as the cutting of teeth, with intestinal colic from unsuitable food and from overfeeding. Rickety children are especially susceptible.

*Treatment.* The child should be placed in a warm bath, and, if there is much fever, ice may be applied to the head with advantage. After being in the bath for five minutes or so, it should be put to bed, and, if the convulsions continue, an inhalation of amyl nitrite should be tried. This is sometimes efficacious. If not, inhalations of chloroform should be given and should be continued whilst other methods are being undertaken and until they have had time to exert their effect. The rectum and colon should be washed out with salt solution, using a soft rubber tube. Chloral hydrate may then be injected *per rectum*. For an infant of three months two grains, and for one of twelve months five grains would be a suitable dose. This may be repeated in an hour if necessary. The chloroform inhalations should be continued pending the absorption of the chloral, only just enough being given to control the spasms. If there is much cyanosis from asphyxia, oxygen inhalations may be temporarily substituted for the chloroform.

If the rectal injection of chloral is not retained, morphia should be given hypodermically. A sixtieth of a grain may be given to a child of six months and repeated in an hour if necessary.

These measures having been instituted the feeding of the child should be inquired into, and if any way unsatisfactory it is wise to empty the stomach. This may sometimes be effected by tickling the fauces with a feather, but this should not be done if the chloroform is still being administered, as vomiting would in this case be attended with the risk of food entering the larynx. The best course is to wash the stomach out through a soft rubber tube. There is no risk of this being in the trachea so long as the breathing is unaffected. Two or three ounces of water should be poured through the tube from a funnel, which should then be depressed below the level of the patient so that the stomach

contents may be expelled. This should be repeated several times so as to empty the stomach thoroughly.

When the fits have subsided and the child is able to swallow, a grain of calomel may be given to empty the intestine of any unsuitable and irritant foodstuff.

The cause of the fits should then be considered and steps taken to prevent recurrence. The possibility of the onset of pneumonia, measles, and other acute infections must be borne in mind, and the existence of symptoms suggestive of gross cerebral disease sought for.

The child should be kept very quiet for several days, and it is advantageous to give small doses of bromide. Attention should be paid to the general hygiene; rickets or adenoids must be treated and errors of feeding corrected.

#### 4. URÆMIC CONVULSIONS

See p. 325.

#### 5. PUERPERAL ECLAMPSIA

In the case of convulsions in women puerperal eclampsia should be kept in mind. This occurs at the latter end of pregnancy or during labour and is of very serious import. Opinion is divided as to the propriety of inducing labour. The immediate treatment is the same as for uræmic convulsions.

#### 6. GROSS DISEASE OF BRAIN AND MEMBRANES

Almost any form of gross intracranial disease may be attended with convulsions. The attacks may be of Jacksonian type, in which the spasms commence in a particular region such as the hand or foot, whence they spread in orderly sequence and may terminate in a general convulsion. Consciousness is not necessarily lost. They occur, for instance, in cerebral tumour and cerebral syphilis, when the diagnosis will rest on other evidence, such as history, headache, vomiting, local paralysis, signs of syphilis, and, above all, on the presence of optic neuritis. The onset of vascular lesions, such as cerebral thrombosis and cerebral embolism, is sometimes accompanied by convulsions which are not always restricted to one side. The apoplectic nature of the attack and the subsequent hemiplegia are characteristic.

In *general paralysis of the insane* fits may occur. This disease should be borne in mind in the case of a middle-aged adult. The pupils should be examined for the Argyll-Robertson reaction and for inequality; the knee-jerks are usually exaggerated, but they

are lost in the tabetic type of the disease. Inquiries should be made for alterations in general behaviour or for more definite mental change. Status epilepticus may occur.

*Treatment.* The importance of these cases lies not so much in the treatment of the convulsive attack, which must be on the general lines laid down for an epileptic fit, as in their recognition as dependent on gross cerebral disease, and the adoption of proper treatment or management of the case after the fit has subsided. Thus antisypilitic remedies may be required, the possibility of trephining may have to be considered, or the future of a general paralytic determined.

## 7. POISONS

Various poisons may give rise to convulsive fits ; only two will be mentioned.

(a) *Alcohol.* Convulsions may occur after a severe bout of drinking, apart from the existence of ordinary epilepsy. The breath smells strongly of alcohol, but, as has been insisted on already, this must never be allowed too much weight, as it is frequently present in convulsive attacks from other causes. The history is of the greatest value. The pupils are equal and generally dilated.

*Treatment.* When there is reason to suspect acute alcoholic poisoning the stomach should be washed out through a soft rubber tube, and collapse treated by stimulants, such as hot coffee *per rectum*, hypodermic injections of strychnine and ether, and by hot applications.

(b) *Lead.* Severe convulsions preceded by headache occur, though rarely, in lead poisoning. The cause may easily be overlooked unless other signs, such as wrist-drop or a history of colic, are forthcoming. The prognosis is grave.

*Treatment.* The patient should be treated as for an ordinary epileptic fit, but in addition lumbar puncture with the withdrawal of cerebro-spinal fluid should be performed, as recovery has been known to follow this procedure.

## 8. MISCELLANEOUS CAUSES

(a) *Severe hæmorrhage.* Convulsions were frequently seen in the old bleeding days, but hæmorrhage is now a rare cause. The treatment is that of hæmorrhage.

(b) *Bradycardia.* Certain cardiac conditions associated with extreme slowness of the pulse give rise to attacks varying in



severity from transient syncope to a general convulsion; the condition is known as the Stokes-Adams syndrome.

The treatment is that of an attack of syncope or of a mild epileptic fit. Little can be done to prevent the recurrence of attacks, as they are commonly due to irremediable disease of the heart muscle, especially of the auriculo-ventricular bundle. Iodide of potassium should be tried, as it has done good in cases due to syphilis.

### III. MENINGITIS

Acute meningitis is classified by Prof. Osler as follows:—

#### A. *Primary*.

1. Of cerebro-spinal fever. (a) Sporadic. (b) Epidemic.
2. Pneumococcic. Meninges involved alone or in a general pneumococcus infection.

#### B. *Secondary*

1. Tuberculous.
2. Pneumococcic. { (a) Secondary to pneumonia, endocarditis, &c.  
(b) Secondary to disease or injury of cranium or its fossæ.
3. Pyogenic. { (a) Following local disease of cranium or a local infection elsewhere.  
(b) Terminal infection in various chronic maladies.
4. Miscellaneous acute infections. In typhoid fever, influenza, diphtheria, gonorrhœa, anthrax, actinomycosis, and other acute diseases.

Of these the most important and the commonest are tuberculous meningitis, acute cerebro-spinal meningitis, and acute pyogenic or septic meningitis.

#### *Symptoms of Acute Meningitis*

Certain general symptoms of acute meningitis will first be discussed, and the special differential symptoms of the various types will be considered later.

The symptoms vary to some extent according as the inflammation is predominantly cortical or basal, and additional symptoms are seen if the spinal meninges are involved.

The onset is usually sudden, with headache, vomiting and fever; a rigor is not uncommon, and in children a convulsion. The pain in the head is very severe, and may be associated with screaming. The temperature rises rapidly to 102° or 103° F., and

sometimes higher. The muscles of the back of the neck are often contracted and painful, and there may be retraction of the head. When the spine is involved severe pains are experienced in the back and limbs, and opisthotonos is not uncommon. The arms and legs may show tonic or clonic spasms, or irregular movements. With involvement of the base of the brain the cranial nerves are affected, squint is common, and there may be facial paralysis, sometimes associated with hemiplegic weakness of the opposite limbs. Delirium is common, and it may be of a furious maniacal type. Vomiting is usual and independent of food. The pulse is at first rapid; with increasing intracranial tension it becomes slow and irregular, but may quicken again at a later period. The pupils are at first contracted but later dilated. Optic neuritis may or may not be present.

In the early stages the patient is irritable and sensitive to light and noise, but later he becomes more apathetic, convulsions may occur from time to time, and ultimately coma develops. Kernig's sign is present: in health, with the thigh flexed at right angles to the abdomen, the leg can be extended so as to be in a straight line with the thigh; in meningitis, and especially when the spinal membranes are involved, spasm of the hamstring muscles prevents this, and the attempt to straighten the leg causes considerable pain.

Owing to the difficulty of swallowing, wasting is rapid and the abdomen is often markedly retracted.

*Differential diagnosis.* It must first be pointed out that at the onset of certain acute specific diseases, especially pneumonia and typhoid, symptoms of meningitis may be present from cerebral congestion without any actual meningeal inflammation. There is usually, however, no paralysis of the cranial nerves which are so frequently affected in actual meningitis, and careful examination may reveal the evidence of pulmonary disease, or if not rapidly fatal the course of the disease will clear up the diagnosis.

Given the symptoms of meningitis a careful general survey of the case should be made. Pyogenic infection should be looked for. Otitis media, mastoiditis, disease or injury of the cranial bones, or of the nasal and accessory cavities, septic foci anywhere in the body, septicæmia, and erysipelas are some of the commoner forerunners of suppurative meningitis.

In infants meningitis is usually tuberculous in nature, and the presence of tuberculous disease elsewhere, as in the lung, or peritoneum, would be a further indication.

The meningitis of cerebro-spinal fever is accompanied by more marked retraction of head, severe pains in back and limbs, and

a very definite Kernig's sign. A petechial rash is common, and there is a marked leucocytosis.

*Lumbar puncture.* This affords the most conclusive diagnostic evidence. The fluid is usually under pressure.

In tuberculous meningitis it is either clear or slightly turbid; on centrifugalization the cells are mainly mononuclear, and finally tubercle bacilli may be found.

In cerebro-spinal fever the fluid is usually turbid or purulent; the cells are mainly polymorphonuclear and usually show the presence of the diplococcus intracellularis.

In suppurative meningitis the fluid is often purulent, and contains enormous numbers of polymorphonuclear cells; cover-slip preparations usually show the presence of pyogenic cocci.

*Treatment.* Certain general measures should be adopted, whatever be the nature of the meningitis. The room should be kept darkened and quiet, and the patient's head slightly raised. It is well to cut the hair short and to apply an ice-bag to the head. The tendency to constipation should be averted by calomel and salines. In the stage of irritation with marked headache, and especially if convulsions occur, a mixture containing bromide and chloral should be given every four hours, but must be discontinued before the stage of coma is reached.

Lumbar puncture is valuable as a means of diminishing the increased intracranial tension. The cerebro-spinal fluid spurts out under pressure, provided that the spinal theca is not shut off from the cranial subarachnoid space by lymph and adhesions. It should not be allowed to escape too quickly, and the needle should be withdrawn as soon as the fluid ceases to flow freely. The relief of headache and even of coma is often marked though transient. The operation may be repeated as the signs of pressure return.

In tuberculous meningitis little more can be done than is above indicated.

In suppurative meningitis thorough surgical treatment of the primary focus of disease is essential; this applies especially to cases of otitis media in which the complete mastoid operation should be performed. Repeated lumbar puncture and withdrawal of fluid have seemed to do some good.

Drainage of the subarachnoid space is stated to have been followed by good results. This is, perhaps, best done at the point of division of the Sylvian fissure, through an opening similar to that described for ligature of the middle meningeal artery.

S. J. Crowe has found that formaldehyde rapidly appears in the cerebro-spinal fluid after the administration of urotropin. This drug might therefore prove to be of value in cases of meningitis, and is worthy of trial.

It is to be noted that in cases of mastoiditis, extradural abscess and sinus thrombosis, symptoms of meningitis may develop which are due to a simple serous effusion in the subarachnoid space; these symptoms subside rapidly when the septic focus is thoroughly dealt with. It is important to bear in mind the possibility of this condition lest a case of this kind presenting meningeal symptoms should be abandoned as hopeless.

In cerebro-spinal meningitis there is a better prospect of recovery. Repeated lumbar punctures with withdrawal of fluid should be performed, and in addition anti-meningococcus serum should be injected into the spinal theca after the removal of the fluid. 20 c.c. may be given daily for a few days.

#### IV. HEADACHE

In the first place disease of the bones of the skull and of the sinuses and accessory cavities, such as the frontal sinus and the antrum of Highmore, may give rise to severe pain. The site of the pain is outside the cranial cavity, though intracranial pain may occur with it. Such local affections may usually be detected by local tenderness or discharge which give the clue both to diagnosis and treatment.

In the case of intracranial pain or headache proper the pain is meningeal in origin, the membranes being innervated by the fifth nerve, whilst the brain substance itself is devoid of sensibility.

Headache may be due to direct local irritation of the sensitive membrane as by a cortical tumour, or to an increase in the intracranial tension such as occurs in the later stages of cerebral tumour, in meningitis, and probably in uræmia.

In addition to these gross organic causes of intracranial pain we have to consider the ordinary forms of headache. The most fully developed form is *migraine*, in which visual and other central disturbances, peripheral vasomotor changes, nausea and vomiting, may also occur. The weight of evidence points strongly to vasomotor change with engorgement of the dura mater and other coverings of the brain as being the cause of the pain. All headaches, however, do not show the peculiar symptom complex of migraine with its marked tendency to recurrence. Many may be related to a definite cause such as constipation, overfeeding,

indigestion, alcohol, fatigue, excitement, and anæmia. It is possible that some of these are dependent on some definite but transient change, such as engorgement of intracranial vessels or even cerebral oedema, as has been suggested in the case of chlorosis. Another common cause is to be found in errors of refraction, especially hypermetropia with its attendant spasm of the ciliary muscle, though the actual mechanism of the pain is obscure; it may be a reflex neuralgia. Neurasthenia is frequently accompanied by vertical headache. Adenoids and nasal obstruction in general are occasional causes. Headache is common in conditions associated with high blood-pressure.

*Treatment.* Every case of headache requires careful investigation. The presence of corroborating symptoms of gross organic disease of the bones of the skull or of the brain should first be sought for. If these are present the case should be treated on the general lines appropriate for such disease; at the same time the symptomatic headache may require to be alleviated by anodyne drugs. Syphilis in particular should be thought of, as it can give rise to the most severe headache, which will often yield promptly with the administration of twenty grains of potassium iodide three times daily, coupled with mercurial inunction.

In the absence of evidence of organic disease careful search should be made for some underlying cause, the treatment of which may diminish or arrest the liability to recurrence of the headache. Constipation should be prevented. Food and especially drink habits may require careful regulation, and a slight limitation of the quantity of food is often very helpful, especially in the gouty and in those leading sedentary lives. The condition of the teeth must be examined and if necessary rectified. Attention to these three points will often completely relieve indigestion and headache. Anæmia should be treated. Errors of refraction should receive attention, though it is a mistake to assume that this measure alone will always prevent recurring attacks of migraine. Neurasthenia should be treated on general lines. The headache accompanying high blood-pressure is often relieved by a course of nitroglycerin.

Calcium has been recommended. Fifteen grains of calcium lactate may be taken three times daily, and we have seen it do good.

*Treatment of the attack.* The treatment of a mild attack of headache in a patient not prone to severe attacks is usually simple. It will often be cut short by aspirin (gr. x to xv), phenacetin or antipyrin (gr. x), or caffein citrate (gr. v). It is advisable also to give a dose of calomel or blue pill at night, followed by a saline purge in the morning.

In severer cases, and especially in patients in whom there is a tendency to recurrence, the problem is more difficult. The sooner treatment is instituted the better. Fortunately some patients are able to predict the headache a day or two before its onset. In such cases the bowels should be thoroughly opened and bromide (gr. x to xv) alone or combined with butyl-chloral (gr. v) may be given three times daily. But often the patient will go to bed well and wake up with the headache. Rest in bed is most advisable, as getting up aggravates the pain and often prolongs the attack. The extremities are often chilly, and hot-water bottles should be employed; at the same time an ice-bag to the head is useful in bad cases. One of the above-mentioned anodyne drugs should be given as soon as possible and repeated if necessary; but care should be taken not to give too large doses of antipyrin and phenacetin. Pyramidon (gr. v) is sometimes useful. If nausea and vomiting occur, drinks of hot water should be taken; the vomiting is rendered easier and the stomach is washed out. Food is as a rule declined, but tea or coffee are often kept down and are beneficial.

The attack may last for a day or two, and often immediate treatment seems absolutely unavailing.

## V. NEURALGIA AND ALLIED AFFECTIONS

The conditions associated with pain of peripheral nerve or spinal root origin are too numerous to allow of detailed description, but some are of such importance, in view of the severe pain attending them, that they claim attention in this book.

### I TRIGEMINAL NEURALGIA

(a) *Minor type.* This may be due to dental caries, suppuration in the antrum or frontal sinus, an impacted wisdom tooth, errors of refraction, nasopharyngeal obstruction, or simple exposure to cold. In addition the possibility of disease at the base of the brain, or of the bones at the base of the skull should not be overlooked. Careful examination should be made for such causes, and they should receive appropriate treatment. This being done the neuralgia will often subside rapidly, but in many cases will require treatment, both general and local.

*Drugs.* A combination of butyl-chloral hydrate (gr. v), tincture of gelsemium (m x), glycerine (m xxx), water to an ounce, given every four hours, is often efficacious. or this may follow an initial dose of aspirin (gr. x), or phenacetin (gr. x), or antipyrin (gr. xv).

These drugs may be given in smaller doses and repeated. If there is any suspicion of syphilis, iodide should be given and may with advantage be combined with salicylate of soda. Morphia should not be given unless the pain is of extreme severity.

*Local treatment.* Local heat by means of a small india-rubber hot-water bottle gives great relief; or hot flannels may be applied sprinkled with belladonna or atropine liniment. A small blister over the temple or over the site of the supra-orbital or infra-orbital nerves is often very helpful.

*General treatment.* It will often be found that the general health is impaired: anæmia may be present or the patient is prone to rheumatic pains or gout. After the acute neuralgia has subsided such conditions should receive most careful consideration, the diet should be supervised, the bowels regulated, exercise and fresh air prescribed, and general tonics given, such as arsenic, iron, and strychnine.

(b) *Major neuralgia or tic-douloureux.* This usually occurs in middle or later life, and arterio-sclerosis is frequently present; but it may affect young adults in good health, and careful examination fails to reveal any of the local troubles so commonly found in the minor neuralgia of the fifth nerve. The paroxysmal attacks of pain gradually increase in severity, and the intervals of freedom become shorter and shorter. The pain usually begins in the second or third division of the nerve, but in the course of time tends to involve all three parts. The slightest movement, such as that involved in talking or eating, suffices to excite a violent paroxysm. Persons have even been known to commit suicide on account of the intolerable pain.

*Treatment.* Medical measures are unavailing except as a temporary expedient. The usual analgesic drugs have very little effect, and in an acute paroxysm morphia, and even inhalations of chloroform, may be necessary. Surgical treatment alone offers any prospect of cure. The simpler methods of injection of the peripheral branches may first be tried. Alcohol (80 per cent) may be injected with a hypodermic needle into the supra-orbital, infra-orbital, or mental foramina.

Even this simple procedure may give striking temporary relief, but it will usually be necessary to advise the injection of alcohol into the main trunks of the second or third divisions of the nerve.

In an intractable case, and especially when the first division is affected, the question of removal of the Gasserian ganglion must be considered.

## 2. SCIATICA

Before making a diagnosis of sciatica a thorough examination of the patient should be made with the view of excluding organic affections such as disease of the hip or sacro-iliac joints, pelvic tumour, lesions of the cauda equina, and carcinoma of the rectum.

Sciatica may come on very rapidly, sometimes even suddenly, and the pain may be of the greatest severity.

*Treatment.* In a severe attack absolute rest in bed is essential and the bowels should be kept freely open. The pain can be relieved by certain drugs, such as aspirin (gr. xv); or a mixture of pot. iod. (gr. x) with sod. salicyl. (gr. xv) may be given three times daily. If the patient is subject to gout, colchicum should be given.

Local treatment is equally important. Heat is always beneficial and may conveniently be applied by means of relays of hot sand-bags or india-rubber hot-water bottles. Counter-irritation may be employed either by means of a series of small blisters applied along the course of the nerve, or by means of the thermocautery, lightly touching the skin in numerous places along the course of the nerve. If these measures fail to give relief, acupuncture may be tried, avoiding any places previously blistered. The patient lies on his face, and several needles are inserted into the back of the thigh over the most painful spots. They must be inserted somewhat deeply, especially the upper ones, and may be left *in situ* for ten or fifteen minutes. In intractable cases the injection of 80 or 100 c.c. of normal saline into the nerve has given very good results: the injection may be made at the point midway between the great trochanter and the ischial tuberosity. After any of these measures the limb should be kept absolutely at rest, and this is best insured by means of a long outside splint.

If severe pain persists in spite of all these measures, the question of surgical treatment should be entertained. The opening of the nerve-sheath at the great sciatic notch is not only followed by complete relief of pain, but it may also prevent recurrence and probably also diminishes the chances of muscular wasting.

## 3. LUMBAGO

Although lumbago must be regarded as an inflammatory affection of the sheaths of the lumbar muscle and of the lumbar and sacral fasciæ, it is convenient to consider it here as it is frequently associated with or followed by sciatica.



*Treatment.* In a severe case the patient must be put to bed. The pain may be so intense that it is imperative to give a hypodermic injection of morphia, and in this case it is well to combine acupuncture with the injection. A sixth or a quarter of a grain of morphia may be injected over the most painful area of each side, and at the same time the needle may be thrust deeply into the tissues in several directions. It is to be noted that the pain is often situated low down over the sacrum rather than in the lumbar muscles. A large linseed and mustard poultice should then be applied over the painful region and repeated frequently.

Internally aspirin (gr. x) may be given three or four times daily, or if there is a suspicion of gout, potassium iodide (gr. x) with vini colchici (℥ xx), and mag. sulph. (gr. xxx), three times daily. It is well also to give at the outset three grains of calomel at night, followed by a saline purge the next morning.

As soon as the acute symptoms have subsided massage must be resorted to, and it is important that this should be entrusted to a really skilled masseur, who will direct his attention to the region involved. Thorough massage will cause the resolution of the inflammatory exudate, which is to be regarded as the underlying cause of the attack. Subsequently care should be directed to the food and drink habits. Overfeeding and over-drinking with insufficient exercise have an undoubted influence in perpetuating the tendency to attacks.

#### 4. THE LIGHTNING PAINS AND CRISES OF TABES DORSALIS

*Lightning pains.* These may often be relieved by the ordinary analgesic drugs and usually require fairly full doses: antipyrin (gr. xx), phenacetin (gr. xx), pyramidon (gr. x), exalgin (gr. iij), aspirin (gr. xv). A course of nitro-glycerin (gr.  $\frac{1}{100}$ ) three times daily is sometimes beneficial.

*Crises.* Of the many forms of crisis which occur in tabes, the gastric crisis is the most distressing. The pain and vomiting may be so severe and persisting as to simulate an acute abdominal affection such as obstruction or peritonitis, and laparotomy has been performed under this error.

On the other hand, gastric and duodenal ulcers are not unknown in tabes, so that the absence of knee-jerks and an Argyll Robertson pupil do not justify us in ignoring the possibility of acute peritonitis.

*Treatment.* All food by the mouth should be withheld, and rectal feeding resorted to if the attack does not subside quickly.

If the blood-pressure is high, liquor trinitrini may be given three times daily in doses of one or two minims. It is almost useless to give ordinary mixtures by the mouth, owing to the vomiting. Phenacetin (gr. xx) or antipyrin (gr. xx) may be tried *per rectum*. Hypodermic injections of morphia give relief, but must be avoided if possible, as the risks of establishing the morphia habit are very great in a chronic disease like tabes.

With severe and repeated attacks, however, it is almost impossible to withhold morphia, and the question of division of the posterior roots of the seventh to the tenth dorsal nerves should be considered. This has been done with complete relief of the symptoms.

#### VI. CEREBRO-SPINAL SYPHILIS

Whilst the later degenerative changes in the nervous system, the so-called parasyphilitic lesions of tabes and general paralysis, do not respond to anti-syphilitic measures, the earlier changes which tend to develop within two or three years of the primary infection improve and sometimes subside under active treatment.

It is therefore of the utmost importance to recognize these changes and to institute vigorous anti-syphilitic treatment as early as possible, and it is for this reason that we have thought it desirable to include a brief summary of cerebro-spinal syphilis in this chapter. The three main pathological conditions which are met with in syphilis are endarteritis, meningitis, and gummata, and these may be met with singly or in combination. The commoner symptoms resulting from these lesions will be briefly described first and the diagnosis later.

##### 1. Vascular Lesions

(a) *Cerebral.* There may be widespread disease of the basal arteries. The middle cerebral artery or its branches to the basal ganglia are very frequently affected, and the commonest clinical manifestation is *hemiplegia*. The gradual narrowing of the artery leads to the production of very characteristic premonitory symptoms of tingling, or of transient weakness in an arm or leg, or of passing aphasia. These are succeeded after a variable interval of a few days or weeks by a rapid or sudden hemiplegia due to thrombosis occurring in the narrowed vessel. Consciousness is often retained or there is a very temporary loss. Syphilis is, by far the commonest cause of hemiplegia occurring in young adults. Other signs of cerebral syphilis, such as headache and vomiting, or absence of the light reflex may also be present.

(b) *Spinal.* Syphilitic disease of the spinal vessels is the commonest cause of the so-called acute myelitis. It may be associated with other signs of cerebro-spinal syphilis, or it occurs in their absence.

As in the case of cerebral thrombosis, premonitory symptoms are common, and comprise sensations of tingling or transient weakness, which may be followed in a few days by a rapid or sudden loss of power and sensation in the legs. In other cases the patient goes to bed well and wakes up paralysed. The symptoms are the result of local softening of the cord following the loss of its blood-supply, and they vary in severity with the extent of the softening.

With a lesion involving the whole transverse section of the cord there will be complete flaccid paralysis with anaesthesia and loss of the deep reflexes below the level of the lesion. There is a great risk of development of large bed-sores, and death may occur rapidly.

If the lesion is not so extensive, the deep reflexes soon return after a temporary abolition, or they may be increased from the outset. Gradual improvement occurs, with slow return of sensation and of muscular power. The initial retention of urine is replaced by incontinence. A spastic condition of the legs gradually develops with a tendency to flexor spasms. Recovery frequently goes on to an extent that allows the patient to get about with the aid of walking-sticks, but with much spastic weakness. The greatest care should be taken with the catheterization as there is a risk of cystitis and suppurative pyelo-nephritis.

In still milder cases recovery may be nearly complete.

## 2. *Syphilitic Meningitis*

(a) *Cerebral.* Both the dura mater and the pia-arachnoid may be affected, and the condition may exist alone or be associated with vascular lesions and gummata. The symptoms necessarily depend on the region affected. If the motor cortex is affected Jacksonian fits are frequently seen.

With basal meningitis symptoms indicative of affection of the cranial nerves develop such as squints, facial weakness, and optic neuritis. Headache is nearly always a marked feature and is often worse at night.

If the meningitis causes blocking of the communications between the cerebral and spinal subarachnoid spaces there is retention of the cerebro-spinal fluid in the cranial cavity with general epileptiform convulsions, drowsiness, and coma.

(b) *Spinal*. Pachymeningitis specially affects the cervical, lumbo-sacral, and cauda equina regions. Pain in the back is common and is often worse at night. Severe radiating pains occur from involvement of the posterior roots, with atrophic paralysis corresponding to the affected motor roots. In the cervical region, for instance, the pains occur in the neck, shoulders, and arms, and muscular atrophy in the thenar and hypotenar groups.

If the meningitis is of such a degree as also to cause compression of the cord, spastic weakness of the legs, exaggeration of the deep reflexes, Babinski's sign and sensory disturbances will be present. If the lesion is above the segments concerned with the superficial abdominal reflexes these will be abolished.

Spinal syphilis not uncommonly takes the form of a meningo-myelitis, namely, a combination of diffuse meningitis with degeneration of a varying zone of the peripheral white matter of the cord from disease of the vessels. The symptoms are those of root pains with gradually increasing weakness of limbs, sensory disturbances, and bladder weakness.

The symptoms of spinal tumour are sometimes very closely mimicked by the presence of tense cystic collections of cerebro-spinal fluid brought about by a matting together of the pia and arachnoid at various levels from syphilitic leptomeningitis. These cases are very readily amenable to surgical treatment.

### 3. *Gummata*

(a) *Cerebral*. Gummata always arise from the pia-arachnoid; they are usually multiple, rarely single. The symptoms of a single gumma are those of cerebral tumour. With multiple gummata there are diffuse symptoms with headache, convulsions, local or general, and later, paralysis and profound mental change.

(b) *Spinal*. A localized gumma is much rarer than gummatous meningitis. It has been found within the medullary substance of the cord. The symptoms are those of a local lesion of the cord.

### 4. *Diffuse Cerebral Syphilis*

With widespread syphilitic cerebral disease, of meningeal, vascular, and gummatous type, a picture may be presented that very closely resembles general paralysis of the insane, but inasmuch as it may improve to a marked extent as the result of treatment its diagnosis is of great importance.

The mental symptoms are usually those of depression. Fits of local or general type are common, but, in addition, there are

indications of local cerebral disease, such as paralysis of cranial nerves, headache, and sometimes vomiting and optic neuritis, whilst the characteristic tremors and speech defects of general paralysis are absent.

#### DIAGNOSIS OF SYPHILIS OF THE NERVOUS SYSTEM

*History.* It is of the utmost importance always to make a very careful inquiry in any case of nervous disease as to a history of syphilis. In the absence of a history of hard chancre that of a soft sore is important, and weight must be attributed even to exposure to the possibility of infection. The possibility of non-venereal contagion must not be forgotten. In women a history of miscarriages is suggestive.

*Signs of syphilis.* Even in the absence of a positive history, examination should be made for signs of present or past syphilis, such as penile scar, ulcers or scars of ulcers on the legs and face and perforation of the palate.

*Condition of the eyes.* Signs of past iritis, and the presence of choroido-retinitis point strongly to syphilis. Inequality and irregularity of the pupils, and especially the absence of the light reflex, are extremely common in syphilitic affections of the nervous system. This loss of the light reflex is often seen in the absence of other signs of cerebral disease, and may give the clue to the nature of an obscure spinal affection.

*Multiplicity of lesions.* Affection of both brain and cord is unusual except in syphilis and disseminated sclerosis.

*Examination of the blood and cerebro-spinal fluid.* The Wasserman serum reaction is of very great value as indicative of syphilis, and combined with a positive result from the cerebro spinal fluid, especially if an excess of lymphocytes were present, would confirm the diagnosis of syphilis of the nervous system. A specimen of the patient's blood (at least 1 c.c.) in a sealed pipette, and of the cerebro-spinal fluid (10-20 c.c.) should be sent to a clinical laboratory in cases of doubtful nature.

*Treatment.* The diagnosis of syphilitic disease of the brain or spinal cord having been made, anti-syphilitic treatment should at once be undertaken.

We would first say that we consider the use of '606' to be at present premature in cases of nervous disease, though wider experience may prove it to be of great value. Similarly, we do not recommend the use of injections of arsenical preparations.

The value of mercury and iodide is beyond question. Mercury

may be given in the form of inunction, a drachm of mercurial ointment being rubbed into the skin daily. The axillary and mammary regions and the loins are convenient sites for its application. Anæsthetic areas should be avoided on account of the risk of producing sloughing of the skin. Iodide of potassium should at the same time be given by the mouth, commencing with 10-grain doses and rapidly increasing the quantity to 20 or even 30 grains three times daily.

The teeth should be thoroughly cleaned night and morning to avoid the risk of mercurial stomatitis as far as possible. Should it occur, the inunction should be stopped for a few days and then resumed in smaller doses or on alternate days ; in any case it is well to intermit the treatment every two months for at least a week. If the symptoms subside rapidly and the patient is able to get up and about it will be more convenient to substitute a pill or medicine containing the mercury in place of the inunction. Hutchinson's pill is very useful, or the liquor hydrarg. perchlor. in drachm or half-drachm doses may be combined with the iodide.

It must be remembered that some cases of syphilis of the nervous system are very intractable, and that in others improvement only takes place to a certain point, a residuum of symptoms remaining which are due to fibrous change in the membranes and degeneration of nerve cells and fibres.

## CHAPTER XX

### EMERGENCIES CONNECTED WITH INSANITY

By R. PERCY SMITH, M.D., F.R.C.P.

#### I. GENERAL CONSIDERATIONS

Every practitioner is certain at some period of his career to have to deal suddenly with a case of insanity, and such cases constitute a very real emergency.

It is necessary to emphasize at the outset that *every mental case may be a medico-legal case*, and so every practitioner of whatever status should make a point of recording *at the time of examination* the results of his observation of the appearance, the acts, and the conversation of patients exhibiting evidence of mental disorder of however slight a nature. The importance of proper notes for subsequent reference cannot be over-estimated. A man who has made notes at the time of examination of the patient cannot easily be upset as to his facts in cross-examination.

Of equal importance is familiarity with the main provisions of the Lunacy Acts, 1890 and 1891, as to the placing of patients under care. It is a common experience that many practitioners have not a copy of the Acts and need instruction of the most elementary kind in this matter.

It is therefore urged that every practitioner should obtain a copy of the Lunacy Acts 1890 and 1891 which can be bought for a few pence, and should also supply himself with the blank forms which are required in order to place patients under care; these can be obtained from any law-stationer.

#### II. EXAMINATION OF PATIENTS

It must be said at the outset that to examine a mental case properly needs more time than almost any other case, and that often the practitioner fails to elicit the symptoms from not taking sufficient time and trouble in his examination.

A. *History.* In every case of insanity *as full a history as possible should be obtained* and recorded. The history should be taken from a near relative, if possible, or from a friend if no

relative is available. In some urgent cases no relative or friend is immediately available, and as much information as possible should then be obtained from the person or persons in contact with the patient. The history and information should be at once written down, and not left to memory which may be unreliable even after a short time; the name, address and description of the informer should be noted, not only for the purposes of the practitioner's own case-book, but because these particulars are required if certification becomes necessary.

The history should be divided into—

1. Family history.
2. Previous history of the patient; general characteristics, occupation, habits, civil and social status, illnesses and previous attacks of insanity.
3. History of present illness; supposed cause, duration, evidence of mental disorder, and conduct.

It is hardly necessary to say that the tendency of those giving the history in cases of insanity is to be diffuse and vague, and therefore their statements need careful sifting. *As conduct is the main criterion by which insanity can be gauged*, it is necessary to ask direct questions as to the patient's words and acts and to ascertain what are the special reasons which have led to the request for medical advice.

B. *Access to the patient.* The next question is how to gain access to the patient. If he be already under treatment for any bodily disease, or if he be a member of a family usually attended by the practitioner, there is as a rule no great difficulty in gaining access to him, but it must always be borne in mind that a person suffering from insanity very commonly has no 'insight' into his condition, that is to say, he does not grasp that he is ill or requires treatment, and, therefore, instead of seeking for advice he repels it as unnecessary or insulting and may resist going to or being visited by a doctor. The relatives may of course be very helpful in this matter, but often they have made it more difficult by inventing some totally imaginary story or even telling a direct lie to the patient. Very often such stories deprive the practitioner of any reasonable pretext for doing anything more than merely looking at the patient, and prevent him from entering into conversation; moreover, they commonly fail to deceive the patient.

Unfortunately, if a practitioner is already in attendance he sometimes makes it very difficult for a consultant by joining in a made-up story as to the reasons for a consultation. It is better



to say nothing rather than make a false statement which may cause permanent distrust in the patient's mind.

It is a good rule that, unless in very exceptional cases, the doctor should visit the patient as a doctor and as no one else, and should frankly state that he has been asked to see the patient as his health has been causing anxiety.

When practicable, a relative or friend should introduce the doctor to the patient, and should not be allowed to give a false name. A practitioner has ordinarily no pretext for breaking into a patient's room unannounced. If such a proceeding has to be undertaken as breaking open a door which is locked or bolted on the inside, the responsibility for this should be taken by members of the family or an official such as the relieving officer or the police. If, however, there is reason to think that a patient locked in a room is about to commit suicide or homicide, for example a mother with a child, time must not be lost, and the practitioner must then use his own judgement. Relatives are very apt to think they can place the whole responsibility in insanity on the doctor and are very unwilling to take their proper share. If there is reason to believe that the patient has lethal weapons the practitioner is perfectly justified in insisting that they shall be removed before his visit. In some cases it is necessary to instal nurses, male or female, before the practitioner can gain access to the patient.

If a patient has locked himself up alone in a house or flat and refuses admission to anybody, and at the same time has given indications that he is suffering from unsoundness of mind, it may be possible to gain access to him only after a magistrate's order for examination has been obtained (Lunacy Act, 1890, sec. 13), or after he has been removed to an infirmary by the relieving officer.

It must always be remembered that for the purpose of certification the interview must be held 'separately from any other practitioner' and, therefore, if two practitioners meet it is well at once to arrange for separate examinations.

C. *General appearance and surroundings of the patient.* Having succeeded in seeing the patient, the practitioner should at once make a quick mental note of the surroundings, such as whether the room is tidy or in disorder, whether there is evidence of destructiveness or any eccentric decoration or arrangement of furniture. He should note the patient's position in the room, as, for example, whether in bed or up, whether sitting or standing or lying in any unusual posture. The conduct of a patient

being of the utmost importance in insanity a note should be also made as to what he is doing at the time.

The appearance and facial expression of the patient in many cases afford invaluable indications of his condition. His facial expression may indicate joy, sorrow, surprise, suspicion, hostility, or anger, or there may be absence of expression and vacuity. Such conditions as absurd or fixed attitudes, partial facial paralysis, marked inequality of pupils, or dribbling of saliva should at once strike the attention. Notice at the same time whether he is dressed in the ordinary way or whether there is untidiness, neglect of cleanliness in dress and person, or absurd decoration. Observations of this nature may form a basis for beginning conversation, but ordinarily it is well to begin by the usual civilities and by saying that one has been asked to see the patient on account of his health, specifying something, such as insomnia, loss of appetite, or constipation, from which he may have suffered.

*D. Mental symptoms.* It is of great importance to gain the patient's confidence, and this is most likely to be done by a natural and self-confident manner such as would be adopted in any other illness.

The general rule of medicine that leading questions should not be asked cannot always be carried out in cases of insanity. Very often the patient avoids the most important subject at first, and the practitioner is obliged gradually to lead up to questions about what the former has said or done which may direct the flow of conversation into the desired channel. A practitioner who avoids asking the patient about the very symptoms attributed to him often fails entirely to form any correct conclusion as to the mental condition.

It is not possible within the scope of this chapter to enter fully upon the examination of the mental symptoms in insanity, but it is most important for the practitioner when called to a mental case to remember the chief functions of the normal mind and to test the patient as to deviations from health.

He should therefore examine for—

(a) Defect and disorder of the special senses; and abnormalities of visceral sensation.

(b) Defect and disorder of perception; hallucinations, and illusions; disorientation, failure of perception of time.

(c) Disorders of consciousness and of the train of thought; retardation or acceleration of the flow of ideas, confusion, incoherence, failure of judgement and reasoning power, loss or alteration of personality.

(d) Defect and disorder of memory, remote or recent ; illusions of memory (paramnesia) and recognition ; failure of recognition and recollection.

(e) Delusions as to self and as to surroundings ; it is important to make sure whether the patient's statements are of the nature of delusion or not, by verification from relatives.

(f) Defect and disorder of emotion ; exaltation and depression ; suspicion and hostility or, on the contrary, too great friendliness or eroticism.

(g) Defect and disorder of will and attention. Failure of attention, loss of decision, impulsiveness, automatism, imperative ideas and acts.

E. *Conduct* being profoundly disordered in insanity the practitioner should pay special attention to it, and should examine for departure from what was the patient's normal conduct, such as extravagance, excitement, garrulity, destructiveness, personal neglect, masturbation, sexual perversion, indecency, filthy habits, violence, homicidal tendency, passivity, silence, resistance, rigid attitudes or rhythmical movements (katatonia), refusal of food, suicidal threats or attempts, inability for self-preservation, inability to follow an occupation or earn a livelihood, disorder of speech or writing, moral perversion or criminal acts. In many cases the chief disorder of conduct exists in what the patient says or writes, and a conclusion has to be arrived at from the nature of his conversation or writing as to whether his condition is such that he cannot be safely left at liberty.

F. *Physical examination.* Serious physical disorder may be masked by the mental symptoms, and it must always be remembered that a statement made by a mental patient as to his condition is not necessarily a delusion, therefore the heart, lungs, abdomen, urine and temperature should be examined as a matter of routine. More especially should the state of the nervous system be carefully examined, as even in what appears at first to be functional insanity signs of organic changes may be found which may indicate the early stages of general paralysis. In all cases, therefore, the following should be noted :—

1. The state of the pupils as to size, inequality, alteration in shape, failure of light reflex, of accommodation, of consensual action and of sympathetic dilatation.
2. Any paralysis of external ocular muscles.
3. Presence or absence of optic neuritis.
4. Any loss of power in facial muscles, or tremor of face on showing teeth or speaking.

5. Tremor or inco-ordination or paralysis of tongue.
6. Tremor or characteristic affection of speech.
7. Weakness of grasp, change in handwriting, inco-ordination or clumsiness in use of the hands.
8. Alteration in gait ; clumsy, paralytic, ataxic or spastic.
9. Alteration in knee-jerks ; exaggerated, lost, or unequal.
10. Loss of control over bladder or rectum.
11. The occurrence of seizures.

Examination of the nervous system may also eventually involve examination of the cerebro-spinal fluid by lumbar puncture for the presence or absence of lymphocytosis, for the Wassermann reaction, or for proteid reaction in cases of suspected general paralysis.

### III. GENERAL DISCUSSION OF THE COURSE TO BE ADOPTED IN CASES OF INSANITY.

In any case of mental disorder to which the practitioner may be called the questions at once arise :—

(a) Is the patient in a condition in which he can still be regarded as fit for full liberty of action ?

(b) Can he be treated in his own home, and, if so, what amount of nursing and supervision is necessary for his proper care ?

(c) Must he be sent away from home for treatment, and, if so, is he fit for single care or for institutional care ?

(a) Very few patients suffering from mental disorder are fit for full personal liberty. There are patients who suffer from hallucinations or from obsessive ideas who are aware of their condition and whose conduct as regards their daily life and occupation is not seriously affected, but these hardly come under the head of emergencies. Directly, however, the conduct (using the word in its widest sense) of the patient is affected the question of deprivation of full personal liberty arises.

Some such patients understand their own condition sufficiently to be willing to place themselves under care in an institution for mental cases, and if the patient be of the private class (as distinguished from pauper) the law allows of his admission as a VOLUNTARY BOARDER in one of the registered hospitals, upon his personal application to the Medical Superintendent and Managing Committee, or into one of the licensed houses (private asylums) with the previous consent of the Commissioners in Lunacy, or Visiting Justices, obtained upon his written application. The Commissioners will not usually give their consent for

voluntary admission if they have reason to think the patient is certifiable, but there are undoubtedly patients who could be certified and yet are anxious to have such special care. This is, perhaps, especially the case where a patient has had previous attacks, and desires to place himself at once under treatment when he is aware that another attack is impending. Until such a patient is certified as of unsound mind and a Reception Order obtained the law regards him as a free agent, and he has the legal right to leave the institution upon giving due notice.

Often the patient is willing to go voluntarily to a doctor's house or private home for borderland cases. The law as to such patients is very stringent, Section 315 of the Lunacy Act of 1890 enacting that 'Every person who, except under the provision of this Act, receives or detains a lunatic, or alleged lunatic, in an institution for lunatics, *or for payment takes charge of, receives to board or lodge, or detains a lunatic or alleged lunatic in an unlicensed house*, shall be guilty of a misdemeanour, and in the latter case shall also be liable to a penalty not exceeding fifty pounds'.

In every case thus treated much will therefore depend upon whether the boarder can be regarded as 'a lunatic or alleged lunatic', and whether he is received for payment. In the case of a boarder who has been thus received for payment and subsequently needs detention under a Reception Order either in the same house or in some other place, the person who has first boarded the patient is almost certain to have a letter from the Commissioners asking for particulars as to the circumstances under which he was received, as to his mental condition at the time, and as to payments. The Commissioners may and do at times prosecute those who have so received borderland or early cases.

Unfortunately at present there exists no clause in the English Lunacy Acts legalizing the temporary reception without the formalities of a Reception Order of those early cases which require much care and supervision and yet need not go to an institution.

Therefore, every one who receives for payment a 'boarder' or borderland case needs to exercise great care to keep within the law.

There is no provision in the Lunacy Acts for the admission of voluntary boarders to county or borough asylums.

(b) The answer to the second question as to fitness for treatment at home depends partly upon the suitability of the home, partly upon the patient's means, and partly upon the nature of the case. A patient whose means allow of his house being

practically given up for his treatment, or whose house and grounds are sufficiently large to provide a separate suite of rooms with accommodation for the necessary nursing staff and for out-of-door exercise, can be treated at home for a much longer period than one who has small means, cramped accommodation, and no opportunity for exercise without being conspicuous or disturbing to the neighbours. A flat or hotel is usually a most unsuitable and dangerous place for the treatment of insanity.

In many cases, whatever the nature of the insanity, the relatives are most averse to sending the patient away from home, and will strain every nerve not to do so, even at the expense of detriment to their own health and at the risk of the patient's life and chances of recovery. Further, they will shut their eyes to the most obvious symptoms, and will enunciate the time-honoured delusion that patients are cruelly treated in asylums and that 'once there they can never be got out again', disregarding the fact that asylums are properly equipped hospitals for a definite group of cases and that asylum nurses are trained and educated for their special duties just as are general hospital nurses. Moreover, the law allows (Lunacy Act, 1890, sec. 72) the removal of a patient from an asylum simply on the order of the petitioner unless very dangerous or suicidal. *It is easier to get a patient out of an asylum than to get one in.*

The following cases can for a time be treated at home under proper supervision :—

1. Very young patients.
2. Senile cases ; when a patient breaks down in advanced age and it is undesirable that the close of life should be in an asylum if it can be avoided.
3. Some of the shorter and milder puerperal cases.
4. Some alcoholic cases, such as delirium tremens, short attacks of moderate excitement, cases of alcoholic polyneuritic psychosis.
5. Some cases of general paralysis of the quiet demented type.
6. Cases of delirious or confusional type.
7. Cases of the obsessional type without imperative ideas leading to dangerous acts.
8. Some of the milder cases of melancholia.
9. Cases in which, on account of the patient's occupation or social position, the avoidance of certification is desirable.
10. Cases of dementia unassociated with active symptoms.

When it has been decided to treat the patient for a time in his own home the question of nursing and supervision arises at once. As a general rule the relatives are totally unfit to nurse

or properly supervise the patient, and skilled assistance should at once be obtained. There are now many mental nurses who have had at least three years training in asylums, who have obtained the certificate of the Medico-Psychological Association, and whose services can be got through one of the nursing associations. A nurse trained only in a general hospital does not as a rule understand the need for constant supervision of a mental patient, and is far less familiar with insanity than an asylum nurse is with general diseases, which, of course, are constantly met with in asylum work.

If a patient is considered fit to be treated at home for a time the importance of night as well as day supervision should always be borne in mind. Very few mental cases can be sufficiently looked after by only one nurse, and those especially in which the symptoms seem at first sight to be mild, namely early cases of melancholia, need more supervision at night than in the daytime, as the early morning is the most dangerous time for suicidal possibilities, and even with a nurse in the room suicide may occur. Moreover, the relations are apt to minimize the symptoms and 'trust' the patient.

The safest plan at first is undoubtedly to keep the patient in bed until it is seen whether he is sleeping and eating properly, whether the evacuations are normal, and what mental symptoms he exhibits. The nurses should be installed in charge of the patient, and the relatives advised to interfere as little as possible.

If it is decided to treat a patient at home it should always be remembered that the risks are far greater than in an asylum. An ordinary house is full of the possibilities of suicide from windows, stairs, knives, razors, blind-cords, and other things. The windows of the patient's room can be prevented from opening fully by small blocks placed over the sash-line, or may be protected by wire netting. Dangerous weapons should be removed, the bolts of the patient's room and of the lavatory doors should be taken off, and the key of the patient's room should be in the possession of the nurse. If possible, the patient's room should be on the ground floor, and care must be taken that he does not gain access to the roof or the windows of upper stories. He should never go up or down stairs, or out-of-doors unattended. If suicidal, his clothing should be searched daily and the bedding before he retires to bed. There is, of course, a natural resistance by a patient to submit to control in his own house, and much tact is needed in this respect, while the relatives do not always support the practitioner in this matter, and are apt to interfere with treatment. He should always be careful to give explicit

orders to the nurses and see that a record is kept of symptoms, diet, and sleep.

In cases where there is maniacal excitement, which as a rule can only be temporarily treated at home, more nursing help is required, the patient usually needing the simultaneous presence of two nurses in the room. When the patient is so excited that he cannot be controlled without constant holding, or without the use of mechanical restraint, or when he has to be confined constantly to one room, he should not be kept long at home, but should be sent to an asylum where mechanical restraint is hardly ever required.

In a private house the noise made by a maniacal patient is very distressing to the relatives and neighbours, and the practitioner is constantly asked for something to keep the patient quiet. With regard to this, it is important to remember that one must not make a desert and call it peace, that although it is possible so to drug a patient that he is constantly torpid, it is wrong treatment and is attended by grave risks.

Although in many cases it is justifiable for a patient to be treated for a time in his own home where the penalties of the law for receiving a person of unsound mind for payment do not apply, yet in cases in which the symptoms are so pronounced and continuous that a large amount of personal control is necessary and yet the relatives will not hear of an asylum, or when a medical man or other authoritative person is put in charge of the patient in his own house, or in a house taken specially, it is advisable to have the patient certified and a Reception Order obtained. In this way he comes under the official cognizance of the Lunacy Commissioners, and the provisions of the Act have to be complied with. (*Vide postea*, 'single care'.)

(c) Must the patient be sent away from home, and, if so, is he fit for single care or an asylum?

Patients who can be treated in single care under certificates correspond largely with those who can be treated at home, but some patients should thus be treated whose recovery is retarded or their symptoms made more acute by the disturbing influences of their own homes or relatives.

The following are unsuitable for home treatment and should be sent to an asylum :—

1. Cases of severe acute mania.
2. Cases of melancholia with marked suicidal or self-mutilating tendency, agitation, or persistent refusal of food.



3. Cases of delusional insanity (paranoia) especially if with ideas of the persecutory type and hostility to relatives or others in the house.

4. Most cases of epileptic insanity and general paralysis.

5. Cases which cannot be safely treated in an ordinary house without resort to mechanical restraint.

6. Cases where exercise is needful and yet it cannot be taken in a garden or in public roads.

7. Any case needing prolonged artificial feeding.

8. Cases showing marked homicidal tendency.

Assuming that the patient is unfit for treatment as a boarder the law requires that, whether he be under 'single care' in a doctor's or other house, or whether he goes to an asylum, a Reception Order must be obtained.

#### IV. CERTIFICATION AND DETENTION

##### A. BY RECEPTION ORDER

For the detention of a patient of the private class, whether in an institution or in 'single care', beyond seven days, the following are the requirements of the Lunacy Acts :—

1. A Petition signed by a relative or friend.
2. A Statement of Particulars.
3. Two Medical Certificates.
4. A Reception Order made by a judicial authority (Justice of the Peace specially appointed, Judge of County Courts, or Magistrate).

The forms prescribed in the Acts must be strictly complied with.

##### 1 and 2. *The Petition and the Statement of Particulars*

These forms are very repellent to the relatives of patients, and although it is their duty to fill up the 'Petition and Statement of Particulars', yet as they are frequently much upset by the patient's insanity it behoves the practitioner to assist them in this duty. Frequently it will save time and lead to greater accuracy if he fills in the blanks, and then, after reading the forms over and having the facts verified, obtains the signature of the person who is to act as petitioner. The blank spaces must be carefully filled up in accordance with the marginal notes. Certain particulars require to be most clearly stated, such as the full name of the patient, the place where he was last seen by the petitioner, and the name of the institution or house to which it is proposed to send him. The date when the petitioner

last saw the patient must be 'some day within fourteen days before the date of presentation of the petition'.

If the petitioner is not related to or connected with the patient, the reasons why the petition is not presented by a relative or connexion and the circumstances under which the petitioner acts must be stated in the proper places.

It is very important to remember that the petitioner must not be related to or connected with either of the persons signing the certificates in the relationships specified in the marginal note of the form. The 'Statement of Particulars' speaks for itself, but both in this and the petition the blanks must be carefully and accurately filled in. Any important omission in this respect may lead to delay in obtaining the Reception Order, and may lead to the refusal of the Lunacy Commissioners to sanction the detention of the patient. Clerical errors may, however, be subsequently corrected within fourteen days by order of the Commissioners.

### 3. *The Medical Certificates*

The two medical certificates accompanying the Petition and Statement of Particulars must be in the form prescribed by the Act. They must be on separate sheets of paper, and one should, wherever practicable, be under the hand of the usual medical attendant (if any) of the patient.

Neither of the certifying medical practitioners may be related in the ways specified in the Lunacy Act 1890, Sec. 32, and they must not be in partnership nor one the assistant of the other.

Certain persons are disqualified from signing either of the certificates; the full list of these is to be found in the Lunacy Act 1890, Sec. 30.

\* Each of the medical practitioners who signs a certificate must have personally examined the patient separately from the other not more than *seven clear days*<sup>1</sup> before the presentation of the petition.

The two practitioners must be registered under the Medical Act and must be in the actual practice of the medical profession. A practitioner who has retired from practice or who is not on the Medical Register cannot sign a certificate.

There are few acts done by a practitioner which require greater care and accuracy, as it must be remembered that a certificate goes far to depriving a person of his liberty. It is unfortunate,

<sup>1</sup> 'Clear days' mean days exclusive of the day of examination and of presentation, e. g. if a patient has been examined on the 1st of a month, the last possible day on which the certificate can be presented with the petition is the 9th.

therefore, that medical certificates often have to be returned by the Commissioners for amplification or amendment.

The same accuracy of detail is required as in the case of the petition; the name, residence, occupation of the patient, and date and place of examination must be carefully filled in, no blank spaces being left unfilled.

Care must be taken that the patient has been examined separately and within the prescribed date, and it must be noted that the examination must lead the practitioner to the conclusion that the patient is a lunatic, *or* an idiot, *or* a person of unsound mind, 'and a proper person to be taken charge of and detained under care and treatment'.

If he cannot come to such a conclusion he is not justified in signing a certificate.

The grounds of the conclusion have to be stated in the body of the certificate under the heading of :—

(a) 'Facts indicating insanity observed by myself at the time of examination.'

This is the essential part of the certificate.

It must always be borne in mind that these 'facts' are the material which the judicial authority (Justice of the Peace, Judge of County Courts, or Magistrate) has to take into consideration before making the Reception Order. Unless the justice of the peace is also a medical man he may be very unfamiliar with the symptoms of insanity, and, therefore, the facts have to be put in plain language, but as concisely as is consistent with showing the marked features of the patient's mental disorder and the conduct resulting from it.

Very often the 'facts' are insufficiently stated, and matters are introduced which, though valuable from the point of view of the case-book, are irrelevant from that of convincing the judicial authority of the necessity for a Reception Order. This may lead to delay in placing the patient under care, as the judicial authority has the right to postpone the consideration of the petition for any time not exceeding seven days, and may require the petitioner, certifying practitioners, and patient to appear before him for further evidence. He may even postpone the consideration for a further fourteen days before making the order.

It must also be remembered that by the Lunacy Act 1890 'every medical certificate made under and for the purposes of this Act shall be evidence of the facts therein appearing and of the judgment therein stated to have been formed by the certifying

medical practitioners on such facts, as if the matters therein appearing had been verified on oath'.

Section 317 as to penalties for wilful misstatements is printed as a footnote to the form of medical certificate.

The lay mind commonly looks upon delusions as the most important feature of insanity. If delusions or hallucinations are referred to in the certificate their exact nature should be stated. In the same way such a condition as loss of memory should not be stated merely in general terms, but instances should be specified. If the patient talks incoherently a sample of his incoherence should be given. Above all any disordered conduct should be specified, such instances as violence, destructiveness, evidence of suicidal or homicidal tendencies, refusal of food, and dirty habits being carefully set out.

(b) 'Facts communicated by others' need not necessarily be filled in if there are sufficiently clear facts in the first and essential part of the certificate, but it is usually desirable to add corroborative facts in the second part, the names, addresses, and description of the informants being fully given. Sometimes, if the facts observed personally by the certifier are few, the facts communicated by others are of special importance, such for example as attempts at suicide, or other insane conduct which the practitioner has not had the opportunity of observing. Care should be taken to be sure of the *bona fides* of the informant.

The certificate closes with a statement as to the fitness or otherwise of the patient's bodily health to allow of removal, and another as to having read the section of the Act as to penalties for wilful misstatements. The certificate is then dated and signed. The date need not be the same as that of examination, but neither of these dates must be more than seven clear days<sup>1</sup> before the presentation of the petition to the judicial authority.

Some practitioners refuse to sign any certificate of lunacy on the ground of the risk of subsequent possible litigation by the patient. It should, however, be borne in mind that clause 330 of the Lunacy Act 1890 affords protection to those who have signed certificates if they have acted in good faith and with reasonable care.

Such proceedings may, upon summary application to the High Court or a Judge thereof, be stayed if the Court or Judge is satisfied that there is no reasonable ground for alleging want of good faith or reasonable care.

Vide footnote, p. 395.

#### 4. *The Reception Order*

The Reception Order is obtained upon a private application to a specially appointed Justice of the Peace, a Judge of County Courts, or a Stipendiary Magistrate. As a matter of practice it is usually made to a Justice of the Peace, the list of specially appointed Justices for each county and quarter sessions borough being published annually by the Clerk of the Peace and obtainable from him.

The Petition, Statement of Particulars, and Certificates must be in order before presentation, and if one of the certificates be not signed by the usual medical attendant the reason must be stated in writing to the Justice. If a previous petition has been dismissed the facts must be stated in the fresh petition (see form), with a copy, obtained from the Lunacy Commissioners at the petitioner's expense, of the statement sent to them of the reasons for its dismissal.

The Justice has the option of seeing the patient before making the order.

If the judicial authority be a relative of the person applying for the order, or of the lunatic, or of the husband or wife of the lunatic, he cannot make a Reception Order.

If the judicial authority dismisses the petition he must give the petitioner a statement in writing of his reason for so doing, and must also send a copy to the Commissioners, or, if the patient is detained under an Urgency Order, must send notice to the person in whose charge the patient is that the petition has been dismissed.

When a Reception Order has been duly made it is sufficient authority for the petitioner or any person authorized by him 'to take the lunatic and convey him to the place mentioned in such order and for his reception and detention therein' within seven *clear days of its date*.<sup>1</sup> If the reception is not carried out within this time the order ceases to have any force.

It is the duty of the petitioner to see that all the documents, namely the petition, statement, medical certificates and order, are delivered to the manager of the institution for lunatics in which, or to the person by whom, the lunatic is to be received.

Without these documents the manager or the person receiving a single patient cannot admit him.

Very commonly the petitioner requests the practitioner or else authorizes nurses to convey the patient to the place of

<sup>1</sup> e.g. An order made on the 1st day of a month remains in force for the purpose of admission to an asylum until the 9th.

detention. Unless there is any special reason against it, it is desirable that a relative or the petitioner should also take part in this.

### B. BY URGENCY ORDER

Although many patients of the private class whose cases may be said to be urgent are dealt with by the completion of the Petition, Statement, Medical Certificates, and Reception Order in one day, yet in other cases even this delay cannot be afforded, or there may be difficulty in arranging promptly for the consideration of the petition by a Justice. The law, therefore, allows of a temporary detention by means of an Urgency Order in the form prescribed by the Act. Clause 11 of the Lunacy Act 1890 enacts that 'in cases of urgency where it is expedient, either for the welfare of the person (not a pauper) alleged to be a lunatic, or for the public safety, that the alleged lunatic should be forthwith placed under care and treatment, he may be received and detained in an institution for lunatics, or as a single patient upon an Urgency Order, made (if possible) by the husband or wife or by a relative of the alleged lunatic, accompanied by one medical certificate'.

The following documents are required :—

1. The Urgency Order.
2. Statement of Particulars.
3. One Medical Certificate with special urgency clause.

The person signing the Urgency Order must be at least twenty-one years of age and must have seen the patient *within two days before*<sup>1</sup> the date of the order, and must not be related to the person signing the Certificate in the ways specified in the marginal note. If not the husband or wife or a relative of the patient, the reasons for this and the circumstances under which the signer acts must be stated in the order.

The Urgency Order may be signed before or after a petition has been presented, and must be referred to in the petition.

Accompanying the Urgency Order must be a Statement of Particulars exactly as in the case of a petition.

The order remains in force *for seven days*<sup>2</sup> *from its date*, or, if a petition is pending, until it is disposed of. The same care as to details must be observed as in the case of a petition. The Urgency Certificate is in the same form as the ordinary certificate

<sup>1</sup> N.B. Two days, not two clear days. If the patient was last seen on the 1st the order cannot be made later than the 3rd.

<sup>2</sup> Seven days, not seven clear days, therefore only valid from the 3rd to the 10th of a month.

accompanying a petition, with the addition of a clause giving the reasons why the patient should be forthwith placed under care and treatment.

It is important to remember that in the case of an Urgency Order 'the lunatic shall not be received under the order unless it appears by the medical certificate that the certifying medical practitioner has personally examined the alleged lunatic *not more than two clear days*<sup>1</sup> *before his reception*'.

In many cases, especially in alcoholic insanity, it is important that, although the Urgency Order and one certificate are made use of, another practitioner shall have examined the patient so as to be prepared to sign the second certificate for subsequent presentation with the petition. If this is not done there is sometimes difficulty in obtaining the second certificate after the patient's admission as the more acute symptoms may rapidly disappear.

The signer of the Urgency Certificate may sign a duplicate of his certificate for the purposes of the petition.

If a petition accompanied by a statement of particulars and two medical certificates is not presented to a judicial authority within *seven days*<sup>2</sup> from the date of the Urgency Order the patient has to be discharged and fresh steps taken. Therefore, when a patient has been admitted under an Urgency Order, no time should be lost in completing the papers necessary for obtaining a Reception Order.

### C. BY SUMMARY RECEPTION ORDER

A Summary Reception Order is one made by a Justice of the Peace without petition and is applicable to :—

- (a) Neglected lunatics.
- (b) Wandering lunatics.
- (c) Pauper lunatics.

(a) *Neglected lunatics.* By Section 13 of the Lunacy Act every constable, relieving officer, or overseer who 'has knowledge' that any person within his district who is *not a pauper and not wandering at large* is deemed to be a lunatic and is not under proper care and control, or is cruelly treated or neglected by any relative or other person in charge of him, shall, within three days after obtaining such knowledge, give information upon oath to a Justice who is a judicial authority under the Act.

<sup>1</sup> Two clear days. If the patient is admitted on the 10th the urgency certificate may be made on facts observed on the 7th.

<sup>2</sup> Seven days, not seven clear days.

The Justice may himself visit the alleged lunatic, and whether he does so or not he shall direct and authorize two medical practitioners to visit and examine the patient and certify as to his mental state. The Justice may then make an order for the patient to be received and detained in any institution for lunatics to which, if a pauper, he might be sent under the Act. The order is made on a special form (No. 15) in the second schedule of the Act. The Statement of Particulars is made and signed by the relieving officer or other person giving the information.

- This procedure is also of use in those cases where a patient (or sometimes two together) of the private class has secluded himself in his own house, refusing to allow his relatives to have access to him, and is acting in a manifestly insane way, becoming a nuisance to his neighbours, or acting in a way dangerous to them or to his own health. If there is no relative available to give the information required it may be the duty of a practitioner who becomes aware of the facts to inform the above-named officials or to give the information himself on oath to the Justice.

(b) *Wandering lunatics.* By Section 15 of the Act every constable, relieving officer, or overseer who has knowledge that any person, *whether a pauper or not*, wandering at large within the district or parish is deemed to be a lunatic, shall immediately apprehend and take him or cause him to be taken before a Justice. Any Justice also who receives information upon oath of any person as to the existence of a wandering lunatic may make an order for his apprehension.

The Justice must examine the patient himself and call in a practitioner to examine him, and if a medical certificate is signed the Justice may make an order for his reception and detention in an institution. The order is also made on a special form (No. 12) as provided in the second schedule to the Act, and is accompanied by a statement of particulars usually signed by the relieving officer.

(c) *Pauper lunatics.* Every medical officer of a Union who has knowledge that a pauper resident within his district is, or is deemed to be, a lunatic, shall within three days give notice to the relieving officer of the district, or if there be none, to the overseer of the parish.

This official on becoming aware by notice from the medical officer or otherwise that a pauper resident in the parish is a lunatic, must within three days give notice to a Justice. The Justice must examine him, either at his own house or else-



where, and call in a medical practitioner to examine him, when the same steps are taken as in the case of wandering lunatics.

The Justice may send a pauper lunatic—

(1) To an asylum either public or private (in the case of private asylums admitting pauper patients).

(2) To a workhouse.

(3) To the custody of friends with outdoor relief.

An important provision of the Act is that in urgent cases a constable, relieving officer, or overseer may remove the alleged lunatic to the workhouse forthwith for detention for three days during which time the proceedings as above required by the Act must be taken.

If the Justice makes an order for the patient's admission to a workhouse his detention is authorized for fourteen days. Further detention in a workhouse is illegal unless a Justice makes a special order (Form 11) upon the certificate of the workhouse medical officer. In cases which become unfit for detention in a workhouse proceedings have to be taken for removal to an asylum.

Many slight cases recover sufficiently in fourteen days to return to their relatives, or else their certification for an asylum or for further workhouse detention becomes difficult and they are released, only to relapse, when the proceedings have to be recommenced.

\* \*

#### V. PATIENTS IN SINGLE CARE

As many medical practitioners receive, or desire to receive, patients into their houses under reception orders in 'single care', it is important for them to note the following duties:

1. If the patient is received under an Urgency Order care must be taken to see that the Order and accompanying certificate are properly filled up and are within the proper dates allowed by the law. The necessary steps must then be taken at once for obtaining the Reception Order.

2. Whether the patient is at first admitted under an Urgency Order or not, the same care must be taken to see that the petition, medical certificates, and Reception Order are correctly completed and within date.

3. It must be remembered that a Reception Order, '*if the same appears to be in conformity with this Act,*' is sufficient authority for reception and detention. The onus lies on the person receiving the patient to see that the Order appears to be in conformity with the Act.

For instance, if the Order has been made on certificates, one or both of which were signed on facts observed more than seven clear days before the presentation of the petition, or if the Order had been made more than seven clear days previously to reception, the person receiving the patient would be breaking the law.

4. If, by the Reception Order, it appears that the patient was not seen by the Justice before making the Order, the patient has within 24 hours to be served in a form prescribed in the Act with 'notice of right' to be taken before or visited by a judicial authority. The patient may exercise this right within seven days after reception (Lunacy Act, Sec. 8) by filling up a statutory form, which must then be posted to the Justice's clerk of the Petty Sessional Division.

If this notice is not served on the patient the 'medical attendant' must, within 24 hours after reception, send a certificate to the Lunacy Commissioners stating that the exercise of such right would be prejudicial.

5. Within one clear day after admission, notice of the admission, with a copy of the Urgency Order, statement, and certificate, or of the Reception Order and of the documents accompanying the same, must be sent to the Lunacy Commissioners, 66 Victoria Street, S.W.

6. Every single patient must have a regular 'medical attendant' who must visit him once at least in every two weeks and must not derive, or have a partner, father, son, or brother deriving, any profit from the care of the patient.

The medical attendant must have the approval of the Commissioners, he must keep the history and full notes of the case in the Medical Journal, and he must, not less than two nor more than seven days after the reception of the patient, send a Medical Statement to the Commissioners in the form required by their Rules.

The regulations as to the correspondence of patients, the use of mechanical restraint or seclusion, as to subsequent reports to the Commissioners, escape and recapture, leave of absence, discharge, and death, will be found in the Lunacy Acts and Rules of the Commissioners with which it is the duty of practitioners receiving single patients to make themselves familiar. It is important to remember that the Reception Order expires at the end of a year from its date unless renewed by a special report and certificate sent to the Commissioners not more than a month and not less than seven days before its expiration (Lunacy Act 1891, Sec. 7). It has also to be renewed subsequently at stated periods.

VI. CERTAIN SPECIAL EMERGENCIES CONNECTED WITH  
INSANITY1. *Suicidal Tendency and Attempts*

The practitioner may be called to a patient who has (a) attempted suicide, or (b) has threatened it, or (c) is found upon examination to have suicidal desires or impulses.

(a) If the patient has attempted suicide in any way, the question of his immediate medical or surgical treatment must depend upon the nature of the attempt and the injuries sustained, and need not be elaborated in this chapter. The importance of the need for immediate and constant supervision both by day and by night must be emphasized, as the patient may seize the opportunity of even momentary absence of the nurse to repeat the attempt. If severe injuries necessitating special surgical nursing have been sustained the nursing staff should be strengthened by asylum-trained nurses, as these are much more conversant with the ways of suicidal patients and the need for constant supervision. After such an attempt the nurse in attendance must not leave the patient's room even for an instant without another nurse or a responsible person replacing him or her.

The mental condition of any patient who has attempted suicide should immediately be inquired into. The attempt may be merely the result of a sudden impulse due to alcoholic excess or sudden emotional stress, or may be only one symptom of a continuing insanity.

In some cases where the patient desperately tries to repeat the act some form of mechanical restraint may be necessary, but in such cases the patient should be promptly certified and sent to an asylum.

(b) In the case of a patient who has threatened suicide there must not be the least hesitation in ordering at once constant skilled supervision both by day and by night. Supervision must not be relaxed until the practitioner feels assured that the mental disorder giving rise to the threat has disappeared, and it is his duty to ascertain what are the patient's thoughts and ideas and whether they have returned to the normal channel. Patients sometimes profess penitence and avow that the attempt will not be repeated, while they maintain the same desire and are totally untrustworthy. While, as a general rule, it may be said that those patients who are quietly suicidal and say little about it and yet watch for any and every opportunity are the most

dangerous, it is a great fallacy (which one hears constantly repeated) to say that patients who talk about suicide will never do it. Many talk about it for a long time, but at last comes the decision. There are many who not only talk about it and about being impelled to do it, but also beg to be protected or even to be mechanically restrained from making any attempt. In such cases it is absolutely cruel to the patient not to afford him constant supervision.

(c) Patients found upon examination to have suicidal desires or impulses.

The majority of these are suffering from mental depression in its various forms. If the case is one that can be managed at home, or in single care under a Reception Order, the need for constant skilled supervision must again be emphasized. The question of asylum care arises at once in suicidal cases. Perhaps the most dangerous cases are those with delusions of obstruction of any part of the alimentary canal, those who have delusions of sexual impotence, those who have dread of death by fire, and those who, without giving utterance to any delusion, make sudden determined attempts. Any case of melancholia must always be regarded as potentially suicidal. Those patients who recognize their own condition and ask to go to an asylum should certainly have the necessary arrangements made as they are often wiser than their relatives with regard to this.

Occasionally patients suffering from maniacal excitement make impulsive attempts at suicide or self-mutilation; general paralytics if depressed may have suicidal desire, and if exalted may desire to do some act which would end in self-injury or death; some epileptics are depressed and suicidal, and stuporous patients may show sudden suicidal frenzy. Those suffering from delusional insanity may seek refuge in death from imaginary persecution.

## 2. *Self-Mutilation*

Patients who do not desire to commit suicide may sometimes as it were accidentally effect this by severe self-mutilation. Such an occurrence as gouging out the eyes may happen suddenly during maniacal excitement, or in obedience to voices, or from some delusion. A patient has been known to cut off her right hand and gouge out her right eye in obedience to the biblical command against offending members. Those addicted to self-abuse may attempt to remove the testicles, or may succeed in removing them and the penis, at great risk of death by hæmorrhage. Another may attempt to remove his own rectum on the

supposition that he has cancer. The possibility of self-mutilation should always be borne in mind in acute cases. Constant supervision is the best safeguard, but in some of those who tend to repeat the act, the addition of some simple mechanical means such as locked fingerless gloves is useful. If the patient is under certificates such restraint has to be recorded in the proper Register and its use certified for.

### 3. *Homicidal Tendency and Attempts*

No patient with homicidal tendency ought to be left at large. In far too many cases are dangerous patients left at liberty until murder occurs. Unfortunately although the practitioner may strongly advise that such a patient shall be certified and placed under care, the relatives often will not take the necessary steps. In some such cases it may be the duty of the practitioner, after warning the relatives, to inform the police or a magistrate of the facts. Perhaps the most dangerous homicidal patients are those suffering from fixed and organized delusions of persecution who have decided to be revenged on their imaginary persecutor. If not certified promptly the end is not unlikely to be a murder followed by a verdict of 'guilty, but insane', and a life-long seclusion in a criminal asylum. Other dangerous homicidal patients are those suffering from epilepsy, some acute maniacal cases, many puerperal and lactational cases, those suffering from insanity with imperative ideas towards homicide, those commanded by 'voices' to commit homicide, some excited and exalted general paralytics, and some cases where depression leads the patient to commit homicide in order that he may be hanged for murder. Many transitory alcoholic cases are for the time being intensely homicidal and may subsequently have no memory of their conduct.

Most of these cases need to be sent to an asylum under an Urgency Order, or, if paupers, to have the matter placed at once in the hands of the police or relieving officer. While steps are being taken to place the patient under care it is a good rule to have *two* efficient and responsible persons always present with him. The patient should be carefully searched for dangerous weapons or missiles.

### 4. *Sudden Dangerous Excitement*

This may occur with great rapidity in very acute maniacal cases, and especially in those due to alcohol, the puerperal state, epilepsy, and general paralysis. The patient should, if possible,

be kept in bed, and at least two efficient nurses should be obtained, with provision for others to succeed them at intervals. A brisk purgative should be given at first. The treatment of such cases in private is difficult. Very often constant handling by nurses irritates the patient more, and unless the patient is likely to be dangerous the less he is held the better. Such cases may be given an amount of liberty in an asylum which cannot be permitted in a private house, where sedative drugs or mechanical restraint, such as the use of towels or sheets tied to the bed are often resorted to. In sthenic cases the wet pack may be used for short periods of not more than an hour at a time and often exercises a calming and sedative effect. Any measures of this kind come under the head of 'mechanical restraint' and under the regulations of the Lunacy Commissioners if the patient is under certificates, and such restraint should never be used by the nurses except under definite medical orders.

For producing sleep paraldehyde, sulphonal, or the bromides are the most useful drugs. Morphia should not be used in maniacal excitement. Hydrobromate of hyosine is often used hypodermically or by the mouth. It should never be given at first in larger doses than gr.  $\frac{1}{150}$ , and its effects need to be most carefully observed as dangerous or fatal collapse may follow. If its use is continued it is apt to cause hallucinations and delirium. Destruction of clothing may be prevented by the use of specially made garments of very strong materials or by the use of padded fingerless gloves. In any case where great excitement or destructiveness continues the patient should be promptly sent to an asylum.

### 5. *Artificial Feeding*

Many insane persons require artificial feeding in consequence of refusal of food. In no case should refusal of food be allowed to continue for more than a very short time. This applies especially to cases where there is already loss of flesh and a state of exhaustion, as in patients suffering from mental disorder of the confusional or delirious type, in whom refusal of food may quickly lead to a condition of danger or to a fatal result. If artificial feeding be begun it must be continued three or more times a day until the patient is taking enough not only to maintain the balance between waste and repair, but to lead to marked physical improvement. In all cases attempts should be made at first to feed by spoon or feeding-cup, and this can often be

effectually carried out by nurses, sometimes assisted by the authoritative presence of the doctor. In any case where force has to be used sufficient assistance should be obtained to control the patient without risk of injury.

Should food be absolutely refused or a totally insufficient quantity be taken, artificial feeding should be instituted without delay by the practitioner, either by the nasal or the œsophageal tube.

1. *Nasal feeding.* A small soft rubber tube of sufficient length to reach into the stomach should be fitted with a funnel. The patient should be in bed or on a mattress on the floor. One nurse should be in charge of the patient's head and care must be taken to avoid injury to the ears in holding the head steady. A towel folded across the forehead and held on each side by the hands is useful. In very resistive cases a nurse is required on each side to hold the hands and control the legs. A broadly folded sheet across the thighs and knees with a nurse sitting on it on each side and simultaneously holding one of the patient's hands avoids bruising. In other cases one nurse may kneel on the bed astride of the patient's knees keeping the sheet down and holding both hands. In no case should a nurse be allowed to sit or kneel on any part of the patient's body or limbs.

The food, consisting of about 1½ pints of warm milk, with two or more eggs beaten up, peptonized if necessary, with the addition of meat extract, fruit juice, and stimulants if ordered, should be at hand. Whatever drugs are required for sleep or purgation can be administered simultaneously. The edges of the nostril should be greased with cold cream or vaseline. The tube being warmed and oiled should then be gradually introduced into one or other nostril and pushed towards the pharynx. The opportunity should be watched for to push the tube onwards as the patient swallows. Care should be taken to see that the tube does not pass into the larynx; this accident would be indicated by the sudden onset of stridor. Many patients continue to talk during the process, an indication that the tube is in the œsophagus and not in the larynx. Some patients have, especially at first, much reflex constriction of the pharyngeal muscles so that the end of the tube may appear in the mouth, in which case it must be withdrawn, cleansed and re-oiled and then reintroduced either in the same or the other nostril. With a little tact the tube is successfully passed beyond the larynx and then should be quickly pressed onwards into the stomach where its entrance is usually signalized by a slight gurgle in the tube. A small quantity of fluid

should then be poured into the funnel to see if it runs properly; if it does the rest should then be poured in, giving time to see that it goes down successfully and does not distend the stomach too quickly. As soon as the feeding is finished the tube should be withdrawn quickly, being at the same time pinched between the fingers so that any fluid remaining in the tube may not empty itself into the pharynx or larynx during withdrawal. Nasal feeding is not usually followed by vomiting, but some patients at first may have retching or vomiting, and if vomiting takes place by the side of the tube it should be withdrawn and the patient be fed again after a short time. In some cases the stomach needs to be washed out before artificial feeding.

2. *Esophageal feeding.* The same preparations should be made as in nasal feeding.

In this case a large soft rubber esophageal tube is used, fitted with a funnel.

A screw gag is needed to open the teeth, sometimes a spoon being first needed to facilitate the introduction of the gag. The ends of the gag should be covered with pieces of rubber tubing to prevent injury to the jaw, teeth, or lips. When the gag is inserted it should not at once be opened to its fullest extent, but a little time should be given for the masseter muscles to tire, then it can be opened to admit the tube. The tube should then be passed back over the tongue and down the pharynx and esophagus. The risk of entering the larynx is much less than with the nasal tube, but the larger tube is more apt to excite vomiting. The tube need not necessarily be passed the whole way into the stomach. It should be withdrawn in the same way as the nasal tube.

Most cases where feeding has to be continued for a long time should be sent to an asylum. It should be remembered that, if sheets or towels are used to control a patient during artificial feeding, the law does not require their use to be recorded as 'mechanical restraint' where they are merely held by nurses for a short time. If, however, they are tied to the bed they come under that heading, and if the patient is under certificates their use must be recorded in the register of mechanical restraint.

### 6. *Insanity complicating other Diseases*

Outbreaks of mental disorder may occur in the course of many diseases, sometimes very acute in intensity but short in duration, and in such cases the mental condition should be



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carefully observed and noted as in the case of insanity arising *de novo*. The same precautions should be taken as in ordinary insanity, and asylum care may be necessary. As instances of diseases liable to be complicated by mental disorder may be mentioned the specific fevers (febrile delirium and post febrile insanity), pneumonia, abscesses and other septic conditions, surgical operations, cardiac disease, phthisis, diabetes, exophthalmic goitre, myxœdema, alcoholism and other drug habits, chronic renal disease, hysteria, neurasthenia, cerebral disease (meningitis, tumours. or head injuries), tabes dorsalis, and epilepsy.

## CHAPTER XXI

### INJURIES AND ACUTE AFFECTIONS OF THE EAR

#### I. FOREIGN BODIES IN THE AUDITORY MEATUS

SUCH bodies as beads, peas, and the like are not infrequently introduced into the external auditory meatus by children and the insane. Unless very small, they are most apt to be lodged at the somewhat narrowed point where the cartilaginous and bony portions of the meatus join one another at an obtuse angle. If pushed beyond that point the difficulty of removal is greatly increased. The ear should always be examined under a good light,

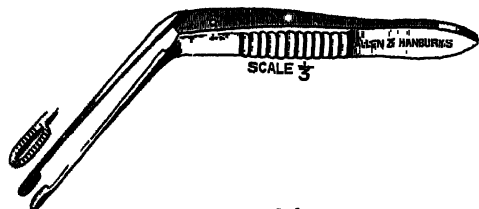


FIG. 89. Aural forceps.

and the exact position and size of the foreign body determined. In attempts at removal, care must be taken that the foreign body is not pressed more deeply into the meatus, as, owing to unskilful manipulations, the tympanic membrane is sometimes injured, or permanent damage done to the meatal walls. The best method of removal is by syringing: a piece of fine rubber tubing should be attached to the nozzle of the syringe and introduced into the meatus, so as almost to touch the foreign body; a strong stream of water should then be projected along the upper wall, whilst the canal is straightened out as far as possible by pulling the auricle upwards and backwards. If this fails, forceps (Fig. 89) may be used, or some form of scoop, or a loop of wire; and if there is any difficulty in keeping the patient still, an anæsthetic should first be administered. If the foreign body has been forced more deeply in, and attempts at removal by any of the previously mentioned procedures have failed, it may be necessary to open into the meatus from behind.

*Operation.* An incision is made behind the ear along the line of junction of the auricle with the scalp, so as to divide the periosteum at the posterior edge of the bony meatus. The cartilaginous portion of the meatus is then separated from the bony portion, and pushed well forward. The meatus is opened by an incision in its long axis. By this means free access is obtained to the deeper parts of the external ear, and the foreign body can be removed with forceps or scoop. If still more room should be required, a portion of the bony meatus may be removed with mallet and gouge. When the foreign body has been removed, the wound must be sutured, and a light antiseptic plug placed in the meatus and changed frequently.

## II. FURUNCLE OF THE EXTERNAL MEATUS

This is usually situated in that part of the cutis lying near the perichondrium or its superficial layers. It occurs often without any known cause in perfectly healthy individuals, or may be due to injury to the meatus, as by the introduction of foreign bodies; or a hair follicle or sweat duct may be infected by pus coming from the middle ear.

The chief symptom is pain, increased by pressure on the ear or on movement of the lower jaw; it is often so intense as to prevent sleep and is usually accompanied by a throbbing in the ear. If the furuncle becomes large enough to block the meatus there may be some deafness, but the hearing is usually unaffected. When the furuncle is situated on the posterior wall there may be redness and œdema over the mastoid process, and at times the abscess extends over the mastoid, when it is usually subcutaneous. The temperature is often raised, reaching in some cases 102° or 103° F.

*Diagnosis.* The diagnosis is made from acute mastoiditis by the fact that pain is caused by movement of the jaw, or by pressure on the auricle or on the tragus; by the presence of the swelling in the meatus; by the fact that the membrane is normal, except for slight redness and dullness on the outer surface; by the normal condition of the hearing; and by the fact that if swelling be present over the mastoid process it is due to œdema or a subcutaneous abscess. In acute mastoiditis, on the other hand, there is no pain on movement of the jaw or on pressure on the auricle; the membrane is usually perforated or bulges forward; there is rarely swelling in the meatus, except when pus has made its way from the antrum along the

vessels which run into the posterior superior wall ; the hearing is diminished ; the swelling over the mastoid process is due to infiltration of the deep parts, and if an abscess is present its position is sub-periosteal. It must not be forgotten, however, that a furuncle may be present at the same time as an acute mastoiditis.

*Treatment.* Incision is extremely painful, and calls for the administration of a general anæsthetic. Gas and oxygen answer the purpose well. The incision must be sufficiently deep to open thoroughly into the inflamed tissues, after which hot fomentations and frequent hot syringing should be employed.

### III. RUPTURE OF THE TYMPANIC MEMBRANE

This may occur (i) by direct penetration of a foreign body into the ear, (ii) by sudden condensation of the air in the meatus, as from a box on the ear or from sudden explosions, (iii) by extension of a fracture of the base of the skull.

In the first case the rupture is more frequently in the posterior part of the membrane, in the second it is more commonly in the anterior half, midway between the manubrium and the tendinous ring, and in the third case a fissure usually extends from the anterior or superior wall.

At the moment of injury a loud subjective noise is heard and a sharp pain is felt, followed by dizziness and tinnitus, which may continue for some days. Bleeding is generally profuse, the blood coming from the ruptured vessels of the membrane, and, in the third class of case, from the fractured bones also.

(On examining the membrane soon after the injury, the opening is seen to be irregular, and its margins are covered with blackish-red extravasated blood. The disturbance of hearing is generally slight.

The treatment in uncomplicated cases is simply to close the meatus with a piece of antiseptic wool, in order to keep out dust. Syringing is not advisable. Should the middle ear become infected, the ordinary treatment for suppurative otitis media must be carried out.

### IV. ACUTE OTITIS MEDIA

#### • (a) *Catarrhal*

This occurs usually in the course of an acute coryza, especially in children suffering from adenoids ; it is characterized by inflammation of the mucous membrane lining the tympanum,

and may give rise to the exudation of a serous or a mucoid fluid into the tympanum. The patient has slight pain in the ear and complains of indistinctness of hearing, and of a feeling of fullness and numbness in the ear, as though water had been left in the meatus.

On examination of the drum it will at first appear reddened and inflamed, with, in some cases, slight outward bulging. Later, the redness disappears and the membrane appears granular owing to the shedding of particles of epithelium; if exudation is present in the tympanum it will be apparent through the membrane as a yellowish layer, usually at the lower part. In the later stages the membrane may be retracted, owing to blockage of the Eustachian tube.

*Treatment* consists in the application of fomentations to the ear, and later, inflations to open up the Eustachian tube. In rare cases, where the fluid in the tympanum persists, paracentesis of the drum may be necessary (see p. 415).

#### (b) *Suppurative*

This occurs most frequently in acute and chronic nasopharyngeal catarrh and during the acute specific fevers, especially scarlet fever, measles, and influenza. The disease usually begins with intense pain in the ear, which is most severe at night. Tenderness on pressure over the mastoid, especially at the apex, is very common, particularly in cases due to influenza; this persists until the escape of the pus. In adults there may be little or no rise of temperature, but in children the temperature may reach 104° or 105° F., and may be accompanied by vomiting, delirium, and convulsions. Facial paralysis occasionally occurs. The hearing is greatly diminished and the patient often complains of subjective noise. The tympanic membrane at first appears injected, especially at its upper part and along the handle of the malleus; later, the whole membrane becomes reddened and cedematous, so that the handle of the malleus is not visible. Marked bulging of the drum, most commonly in the posterior and upper part, often occurs. Rupture of the drum may take place, usually about the third day after the onset of the inflammation, and, with the discharge of the pus, the pain subsides in uncomplicated cases.

*Treatment.* In the early stages of the disease treatment consists in the application of hot fomentations. After the membrane has ruptured, the meatus must be kept clean by syringing with some antiseptic lotion, or by dropping in a solution of

hydrogen peroxide, which should be retained for about five minutes. Special attention must be paid to keeping the perforation open until all discharge has ceased. In cases where the membrane bulges, with pain over the mastoid process and marked constitutional symptoms, paracentesis of the membrane should be performed as early as possible, to allow of the escape of the pus.

*Operation.* Paracentesis of the tympanic membrane is performed as follows. In children and the timid a general anæsthetic is required, for which purpose nitrous oxide gas and oxygen will usually be sufficient. In others it is sufficient to drop some 10 per

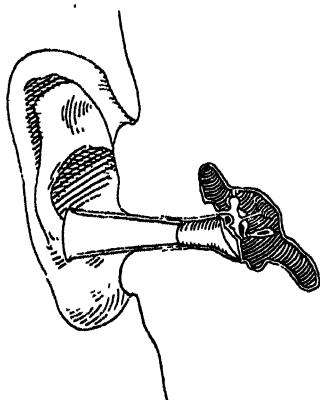


FIG. 90. Paracentesis of drum: speculum in position.

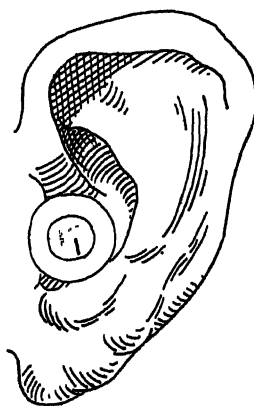


FIG. 91. Incision into tympanic membrane through a speculum.

cent cocaine solution into the ear a few minutes before the incision is made. As large a speculum as the meatus will admit is then introduced, and the membrane incised in the postero-inferior quadrant (Figs. 90 and 91). Special knives are made for this purpose, but in an emergency a sharp-pointed tenotome answers the purpose admirably. After the incision, frequent gentle syringing with boracic lotion, and the application of hot fomentations will be required.

#### V. ACUTE MASTOIDITIS

This comes on with marked pain in the ear, which radiates over the side of the head; it usually occurs some days after the onset

of an acute suppurative otitis, or at any time during a chronic otorrhœa, when it is often associated with a cessation or complete stoppage of the discharge. In children it is accompanied by headache, vomiting, high fever, sometimes rigors, a rapid pulse, and the other signs of an acute periostitis, but in adults it is not uncommon to find very little rise of temperature, and a pulse-rate only slightly above the normal.

On examination in the early stages there is tenderness on pressure over the mastoid, especially over the apex; later there may be redness and œdema of the soft parts, and at a still later stage an abscess may appear. This is formed by the pus making its way through the outer wall of the antrum, or in young children through the squamo-mastoid suture, as this is present in the



FIG. 92. Acute suppurative mastoiditis, with sub-periosteal abscess and great œdema of temporal region and face, displacing the auricle and closing the eye. (Thomson and Miles.)

child, and sometimes persists till puberty. The abscess makes its way upwards and forwards, because the periosteum in that direction is more easily separated from the bone than at other parts; the ear is thus pushed forwards and lies at a rather lower level than the other ear (Fig. 92).

In rare cases the bone becomes perforated on the inner side of the apex of the mastoid process, and the pus finds its way into the digastric fossa, so that an abscess forms in the neck beneath the sterno-mastoid muscle.

In almost all cases deafness is well marked, though in rare instances, chiefly of tuberculous origin, the tympanum may be normal, and yet the mastoid process may be completely riddled with granulation tissue and pus.

In making the diagnosis acute mastoiditis has to be distinguished from :—

(a) Glandular abscess over the mastoid process. This is done by the examination of the tympanic membrane and of the hearing; in most cases the primary cause of the inflamed gland will be seen, usually on the scalp.

(b) Furuncle in the meatus. See p. 412.

*Operation for acute mastoiditis supervening on an ACUTE  
otitis media*

A sufficient area of the scalp having been shaved behind the ear and the patient anæsthetized, the head is placed in a convenient position upon a flat sand-bag. The incision, which passes at once down to the bone, commences close to the top of the attachment of the auricular cartilage to the scalp, passes downwards in a slightly curved direction about half an inch behind the pinna, and terminates just below the apex of the mastoid process. The pinna is then pushed forward until the edge of the bony meatus is just exposed, and is then held forward by means of a 'rake' retractor. The supra-meatal spine can now be seen and felt. This is a small bony prominence situated at the junction of the upper and posterior borders of the exposed meatus, and provides the guide to the position of the antrum which lies a quarter of an inch behind this spine. By means of a gouge and mallet the outer wall of the antrum is removed, and such of the other cells as may be deemed to be infected opened up. The posterior wall of the bony meatus is not removed, neither is the tympanum interfered with. The operation is completed by plugging the wound and applying a dressing. At times, especially in cases due to scarlet fever, definite sequestra may be found, and must then be removed; and should the necrosis involve the deeper parts it may be necessary to perform the complete operation.

*Operation for acute mastoiditis supervening on a CHRONIC  
otitis media*

When the acute inflammation supervenes upon a chronic otorrhœa, so that the tympanic membrane has been more or less destroyed, the ossicles are carious, and the tympanum and mastoid process, especially the antrum, are extensively diseased, a more radical operation becomes necessary. The antrum and mastoid cells are to be opened up thoroughly, as in the operation



just described, and in addition the posterior wall of the bony meatus is to be chiselled away, together with the outer wall of the attic, which is formed by the roof of the bony meatus. At the same time the tympanum is to be cleared with the curette of all granulations and what may remain of the tympanic membrane, together with the malleus, but the stapes should not be interfered with. In this manner the external auditory meatus, the tympanum, attic, mastoid antrum, and mastoid cells are all thrown into one continuous cavity (Fig. 93). The walls of this cavity are gouged away so far as may be necessary to ensure removal

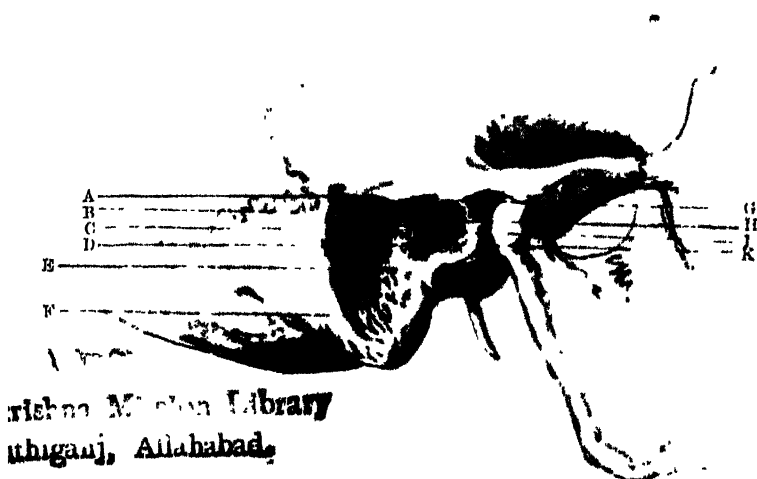


FIG. 93. A, Antral roof; B, Facial canal; C, External semicircular canal; D, Remains of posterior meatal wall; E, Lateral sinus; F, Mastoid cells; G, Tympanic roof; H, Fenestra ovalis; I, Eustachian tube; K, Fenestra rotunda.

of all the carious bone. In so doing it may be found necessary to expose the lateral sinus and the dura mater of the middle fossa; no risk attaches to the exposure of these structures, provided that they are not accidentally wounded. The safety of the facial nerve is best secured by remembering that, after running backwards in the upper part of the inner wall of the tympanum above the fenestra ovalis and below the horizontal semicircular canal, it turns abruptly downwards and forms the inner boundary of the narrow canal leading from the tympanum to the antrum, namely, the aditus ad antrum. The canal in which the nerve lies can be seen distinctly, and it is only by keeping its position in view whilst operating in its neighbourhood that it can with certainty be preserved from injury.

When the bony operation has been completed the wound is syringed out and plugged. The cartilaginous meatus should at the same time be enlarged so that subsequent treatment can be done through the meatus. If the operator does not feel sufficiently experienced to attempt the systematic removal of the whole of the diseased bone with safety, he may rest content with relieving the acute symptoms by the opening and drainage of all the pus-containing cavities, and leave the radical cure of the bone disease to be completed at a subsequent operation.

- *After-treatment.* Healing may be hastened by covering the wall of the cavity with a 'Thiersch' graft at a second operation (for details of which the reader is referred to works on operative surgery), but many of these acute cases will heal soundly if the cavity is carefully syringed and plugged daily.

## VI. COMPLICATIONS OF ACUTE MASTOIDITIS

### (a) *Extradural abscess*

By an extradural abscess is meant a collection of pus between the dura mater and the bone. The commonest situations are in the middle fossa just above the roof of the tympanum and antrum, and in the posterior fossa, in the groove of the lateral sinus. The latter is the more frequent site of such a collection of pus.

There are no symptoms by means of which this complication can be definitely recognized, and it is often found unexpectedly in the course of the operation just described. If it is present, and the diseased bone is carefully removed by following out all nooks and crannies and carious spots, it can scarcely fail to be encountered. Before operation its presence may be suspected if the tenderness and cedema are situated beyond the limits of the mastoid process, and if, without any other signs of cerebral abscess, commencing optic neuritis is present. The dura may be covered with granulations, or may be quite unaltered except for slight hyperæmia. In cases of chronic otorrhœa, especially if combined with a cholesteatoma, the abscess is more circumscribed, and the dura appears of a greyish green colour and has a greater tendency to become necrotic.

### (b) *Sinus thrombosis*

In a neglected case of mastoiditis, infection may spread to the lateral sinus either directly, as when the pus of an extradural abscess bathes its wall, or by extending along some tributary

vein. During the process of thrombosis, whilst there is still a current of blood flowing through the sinus, fragments of the infected clot are apt to become dislodged and carried into the circulation, thus causing the further complication of *pyæmia*. Sinus thrombosis may be recognized if, in addition to the other symptoms of acute mastoiditis, there are rigors, intense headache, vomiting, and pain in the neck along the course of the jugular vein, although it must not be forgotten that such pain may be caused by a chain of inflamed glands. In a neglected case there may be present, in addition, definite signs of *pyæmia*, such as effusion into joints or abscesses in the lungs. The thrombosis sometimes spreads to the cavernous sinus along the petrosal sinuses. This is shown by the onset of ophthalmoplegia and proptosis, first on one side and then on the other, and when this occurs a fatal termination is inevitable.

*Treatment* must be directed to the prevention of any further fragments of clot entering the circulation, and this is accomplished by ligaturing the internal jugular vein. If the sinus thrombosis is recognized before operation it is best to tie the vein before the mastoid operation is performed. But sometimes the condition is only diagnosed during the progress of the mastoid operation, when the sinus is exposed. In such a case the vein must be tied afterwards.

*Operation.* An incision, three inches long, with its centre placed opposite the cricoid cartilage, is made in a line extending from midway between the angle of the jaw and the mastoid process to the sterno-clavicular joint (Fig. 94). The deep fascia having been divided, the anterior border of the sterno-mastoid is defined and the muscle retracted. The omo-hyoid may be seen and drawn downwards with a retractor. The vein is then isolated from the carotid artery and vagus nerve and divided between two ligatures. Any tributary veins that can be found above the site of ligature, particularly the common facial, should be tied.

The complete mastoid operation must next be performed as described above, and the removal of bone carried backwards so as thoroughly to expose not less than two inches of the sinus (Fig. 93). The dura mater which forms its outer wall is next cut away, and the purulent clot evacuated. At this stage free bleeding may ensue, particularly if the thrombosis of the sinus was incomplete. This is readily arrested by plugging the sinus with a strip of sterile gauze pushed towards the torcular.

*After-treatment.* The whole large wound is left widely open, to be syringed and plugged daily. Pyæmic abscesses may have to

be dealt with, and if the symptoms do not subside, trial should be made of an antitoxin injected subcutaneously. Unless the actual organisms concerned in the case are known, any antitoxin that may be employed must necessarily be used empirically. But as the majority of these cases are due to infection with some form either of staphylococcus or streptococcus, the serum selected should be either a multivalent antistaphylococcic or a multivalent antistreptococcic serum. If two or three large doses of the one

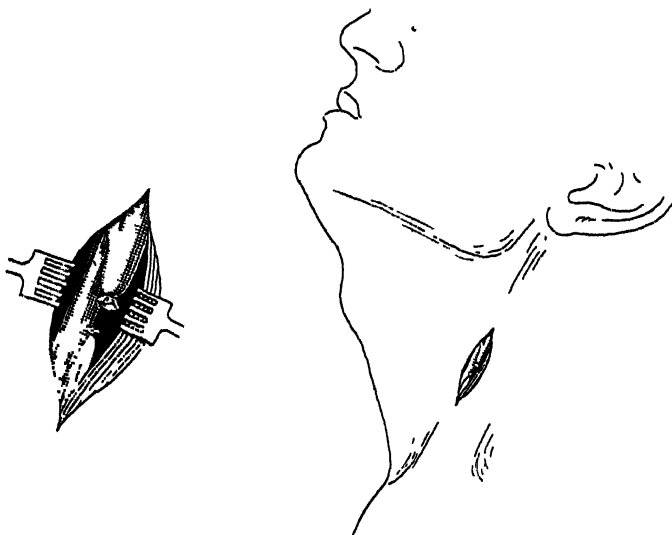


FIG. 94. Ligation of internal jugular vein.

produce no effect, then the other should be tried. In either case doses of not less than 40 c.c. should be given, at intervals of from eight to twelve hours.

#### (c) *Cerebral abscess*

As a complication of mastoiditis, cerebral abscess is most frequently found in the temporo-sphenoidal lobe, and next to that in the cerebellum. Of 38 consecutive cases at St. Thomas's Hospital, 22 were temporal, 13 cerebellar, and 3 multiple. Occasionally it is encountered accidentally during the progress of a mastoid operation: if such a case the membranes have become adherent on the one side to the abscess wall, and on the other to the diseased bone.\*

But as a rule a train of symptoms is superadded to those of

the mastoid disease which enable a diagnosis to be made before the mastoid operation is undertaken. Sometimes, on the other hand, the symptoms of cerebral abscess only manifest themselves some days or even weeks after the mastoid operation has been performed.

In the very acute cases the cerebral tissue is widely and rapidly invaded, causing a diffuse septic softening and accompanied by a diffuse purulent meningitis. The prominent symptoms are firstly those of acute toxæmia and secondly those of cerebral compression. In these cases a fatal termination is almost, invariable.

In the less acute cases the abscess is usually more or less encapsuled. The symptoms by which an abscess of this kind can be recognized are *general* and *focal*. The general symptoms comprise headache, drowsiness, vomiting, slowing of the pulse-rate, subnormal temperature, and optic neuritis. These are the symptoms of cerebral compression, and they are superimposed upon those of the toxæmia from septic absorption. They thus mask to a greater or lesser extent the toxic symptoms, especially as regards the pulse and temperature.

The focal symptoms depend upon the situation of the abscess. The most prominent symptom of *temporo-sphenoidal* abscess is weakness or paralysis of the opposite side of the body. If the abscess is upon the left side, word-deafness may be present. Ptosis, external squint, and dilatation of the pupil of the same side, due to paralysis of the third nerve, are not infrequently present. There is also a characteristic slowness of cerebration which is a symptom of great importance. The patient hears and understands quite well what is said to him, but takes a very long time to answer: when he does so he gives a correct answer. This state may be mistaken for aphasia unless care be taken.

Among the symptoms of *cerebellar* abscess may be noted disturbance of gait, shown by a tendency to stagger and fall towards the side of the lesion; vertigo; inco-ordination; occipital headache; sometimes retraction of the head, which may also be flexed towards the side of the lesion, and nystagmus, especially marked during movement of the eyes towards the affected side; there may also be an increasing slowing of the respiration until asphyxia results, in which case relief of pressure by evacuation of the pus becomes a matter of extreme urgency. Weakness of the limbs of the same side of the body may occur, and the deep reflexes tend to be diminished.

*Operation.* The operation for brain abscess complicating

mastoiditis necessitates not only drainage of the abscess itself but also removal of the primary source of the infection. It is sometimes recommended that a separate opening should be made for the abscess, on the ground that there is less risk of infecting the tissues which have to be traversed in order to reach the pus. It is, however, usually better to evacuate the abscess along the course of infection; indeed, the abscess frequently lies so close to the diseased bone that the double operation would be impracticable.

• The mastoid operation having been completed and the lateral sinus exposed, the opening in the bone is to be enlarged either downwards and backwards, or upwards and forwards, according as to whether the abscess is judged to be below or above the tentorium cerebelli. Information as to the position will be obtained by the colour and tenseness of the dura mater, and the presence or absence of pulsation. The dura sometimes has a yellowish appearance in the near neighbourhood of the abscess, and if the pus is close beneath it, the dura may be deeply congested, plum coloured, or even gangrenous and sloughy. The dura is to be opened as close to the supposed site of the abscess as possible, and an incision made with a scalpel into the brain tissue. Exploration by means of a trocar and cannula is not to be recommended, for it frequently fails to reveal the presence of pus even when, as is occasionally demonstrated in the post-mortem room, the instrument has actually entered the abscess cavity. The pus having been found, a finger is gently thrust through the incision in the cortex, so as to enlarge it sufficiently, and a rubber drainage tube inserted and held in place by a stitch passed between it and the edge of the dura mater.

• *After-treatment.* The cavity may be very gently syringed out daily and the tube gradually shortened until it can be omitted altogether. It is a good plan to pass a fine gauze wick down the tube. This allows the lumen to be cleared, at the next dressing, of thick pus and débris of brain tissue, without removing the tube from its track.

#### (d) *Meningitis*

• *Meningitis* is dealt with at p. 370. It is the usual cause of death in cerebral abscess.

## CHAPTER XXII

### INJURIES AND ACUTE AFFECTIONS OF THE EYE

By J. F. CUNNINGHAM, F.R.C.S.

#### I. INJURIES

##### A. INJURIES OF THE EYELIDS

(a) In *contusions* the swelling may be limited by applying cold or an evaporating lotion, bearing in mind this caution, that a lead lotion must not be used when any abrasion of the cornea is suspected, lest a white deposit of lead carbonate be formed on the cornea.

(b) *Insect stings* cause considerable swelling. The site of the punctures, if recent, should be touched with liquor ammoniac to neutralize the acid poison, and hot fomentations applied.

(c) *Wounds of the lid* should be treated on general surgical lines. The possibility of perforation and injury to the globe should always be borne in mind. Should the tarsal cartilage be divided the cut edges must be brought together with a buried silk suture. If one of the canaliculi has been divided, an attempt should be made to find the end nearest the lacrimal sac, and a fine silver probe should then be passed from the punctum along the whole length of the divided canaliculus and retained there. The wound is then sutured with the probe *in situ*. If the levator palpebræ muscle has been divided, it should, if possible, be sutured.

##### B. INJURIES OF THE CONJUNCTIVA

(a) *Foreign bodies*, such as pieces of cinder, frequently lodge in the conjunctival sac; they may be seen in the lower fornix by directing the patient to look upwards and drawing down the lower lid. They may be found lodged under the upper lid, in which case the lid must be everted in order to remove them. To evert the upper lid the patient is directed to look downwards while the surgeon stands in front of him. The surgeon takes hold of the lid margin and the lashes between the index-finger and the thumb, the thumb being lowermost. The lid is then drawn downwards and away from the globe, and put slightly on the stretch. At the same time a finger of the other hand is placed over the upper limit of the tarsal cartilage and pressed downwards

and a little forwards while the lid is turned up by the thumb and finger. It is sometimes easier to evert the lid over a probe or the rounded end of a penholder than over the finger.

The foreign body is usually lodged in the sulcus subtarsalis, a few millimetres from the free margin of the lid. Occasionally it is found in the superior fornix or cul-de-sac of the conjunctiva. This may be explored as follows: while the upper lid is everted and fixed above by the thumb, the patient is directed to look downwards and inwards, and pressure backwards is applied on the globe through the lower lid, when the superior fornix can be made to start forwards.

(b) *Wounds involving the conjunctiva only.* A few drops of 2 per cent cocaine are used, and after irrigating the eye with sterilized normal saline solution, the wound is brought together with fine silk sutures, and a pad and bandage applied.

Irrigation of the conjunctiva is most conveniently done from an 'undine' (Fig. 95). The lower lid is drawn down and the patient is asked to look in various directions while the undine is employed. Similarly the upper lid may be everted, but when there is any possibility of escape of the intra-ocular contents, as in ruptured globe, this must be done very carefully, if at all, in order to avoid any pressure on the globe.

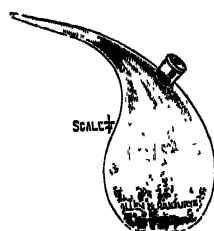


FIG. 95. 'Undine.'

## C. INJURIES OF THE CORNEA

(a) *Abrasions* of the cornea are often infected at the time of injury. The conjunctival sac should be irrigated with warm normal saline or boracic lotion, a drop of atropine solution (1 per cent) instilled into the eye, and a pad and bandage applied. The eye should be kept tied up for two or three days until the epithelium has grown over the abraded surface. The bandage should be reapplied two or three times a day and the lids bathed with boracic lotion. Should there be any inflammatory condition of the lacrimal sac the danger of infection is much increased. In infected abrasions an ointment containing atropine ( $\frac{1}{2}$  per cent) and precipitated iodoform (10 per cent) should be employed.

(b) *Foreign bodies* on or embedded in the cornea require removal. A foreign body on the cornea can be removed with a clean piece of blotting-paper, after the use of a 2 per cent solution of cocaine.



Foreign bodies in the substance of the cornea should be removed with an ophthalmic needle or a spud, but preferably the former, as it causes less destruction of corneal tissue.

*Operation.* The eye being well anesthetized with 2 per cent cocaine, the surgeon stands behind the patient, who, seated in a chair, has his head steadied by means of a rest or against the surgeon's chest. The patient is asked to open the eyes, and to look steadily at some object in front of him, so that the foreign body is brought well into view. This is aided by an assistant focussing light on the cornea with a convex lens. The eye is steadied between the index and middle fingers of the left hand. In removing foreign bodies from the cornea it must be remembered that the resulting scar, if central, may seriously interfere with vision, and therefore it is advisable to work with the needle in a direction away from the centre of the cornea as much as possible. This precaution also lessens the risk of injuring the eye, in case a nervous patient should move it during the procedure.

In removing a particle of iron, the brown ring formed round it should be gently scraped away. The eye should be irrigated and the same after-treatment adopted as described for abrasions.

In the rarer case of a foreign body buried deeply in the cornea, or projecting into the anterior chamber, an instrument should be carefully passed behind it to prevent it slipping back into the anterior chamber before its removal can be attempted.

#### D. INJURIES OF THE GLOBE

(a) *Contusion.* Injury of the globe by contusion may give rise to many serious conditions, and a thorough and systematic examination of the eye is necessary before it can be definitely said to be uninjured.

The eyes are first looked at from some little distance, and any protrusion (exophthalmos) or the reverse noted. The movements of the globe are then tested, by making the patient follow the finger.

The vision should also be tested.

The eyes are then examined by oblique illumination, the light being focussed on the globe with a lens; this is best carried out in a dark room.

The *cornea* is first examined, and then the *anterior chamber*. Notice any alteration in the depth of the latter as indicating displacement of the lens; the anterior chamber may be very shallow or obliterated after perforation of the cornea. The

anterior chamber may be filled with blood : a small quantity collects in its lower part (hyphæma).

The *iris*. Note the position, shape, size, and reaction of the pupil. Also examine the iris to see if there is any detachment at its root (irido-dialysis), or foreign body embedded in its substance. A tremulous iris, on quick movement of the eye, indicates that it has lost the support of the lens behind it.

The portion of the lens that is visible in the pupil may show opacities if they are far forward. With transmitted light, from the ophthalmoscope, the lens can be more fully examined, and a traumatic cataract or the edge of a dislocated lens can be seen. Hamorrhage in the vitreous, ruptured choroid, or a detached retina, should be looked for with the ophthalmoscope.

*Treatment.* Hamorrhage into the anterior chamber may be associated with irido-dialysis or with laceration of the pupillary border of the iris. In the former condition atropine is used ; in the latter it is contra-indicated. In both these cases a pad and bandage should be applied and rest enjoined. Cold compresses may be employed to relieve pain.

Hamorrhage into the vitreous, which may perhaps be obscuring a ruptured choroid or a detached retina, requires similar treatment and atropine should be used.

Hamorrhage into the orbit will cause exophthalmos and swelling of the lids, and should be treated by cold applications.

A dislocation of the lens may call for operative interference in the near future, especially if it is displaced forward or if the dislocation is subconjunctival. What is most to be feared in the former case is secondary glaucoma.

A traumatic cataract may be produced by rupture of the lens capsule and may call for surgical intervention at a later date. A lens dislocated beneath the conjunctiva should not be removed until the track along which it has travelled has had time to heal, as the risk of infection is thereby diminished.

(b) *Penetrating wounds.* In penetrating wounds two contingencies must always be borne in mind :—

(i) Infection.

(ii) The retention of a foreign body, such as a pellet of shot, in the eye.

If a foreign body be retained, the eye is always a potential source of sympathetic ophthalmia in the other eye. Sympathetic ophthalmia need not be feared for two weeks at the earliest ; but removal is easier before the foreign body becomes encased in exudate. It is therefore advisable to have recourse to the

X-rays as soon as possible. If the foreign body throws a shadow with the rays it can be accurately located, and if magnetizable can be removed with the electro-magnet.

In perforating wounds of the cornea the aqueous escapes and there is great danger of prolapse of the iris. If this occurs after the instillation of cocaine and irrigation, the iris should be separated from any adhesions that may exist and the prolapsed part removed.

Even if prolapse does not occur, rest in bed with the eye tied up is required, and atropine is to be used. If, however, the wound is peripheral, eserine ( $\frac{1}{4}$  per cent) may be used to contract the pupil and prevent synechiæ. Eserine, however, has a tendency to aggravate any iritis that may occur, so that if signs of iritis supervene its use must be discontinued and atropine substituted.

(c) *Rupture of the globe* commonly results from a blow with the fist or some blunt object. In these latter so-called indirect ruptures, which are generally situated above, and follow the curve of the cornea a few millimetres from the sclero-corneal margin, there is not so much danger of infection at the time of injury, though wounds in the ciliary region are more liable to give rise to sympathetic ophthalmia than those elsewhere.

*Treatment.* Every case must be weighed on its own merits, and the previous visual acuity of the two eyes must be taken into account in deciding upon the line of treatment to be adopted. There are but few cases in which the immediate removal of the eye can be reckoned as a matter of pressing urgency. These are when the globe is hopelessly disorganized or infected with septic material. Excision is called for, though not necessarily at once, in very extensive ruptures, particularly if a large quantity of vitreous has been lost, and especially if there is also extrusion of the iris and lens. Cases with prolapse of iris call for early operative interference and should not be subjected to expectant treatment. In all cases the eye must be very gently handled, and a general anæsthetic is often necessary in making the examination before a definite opinion can be expressed as to the chance of saving it.

If it is decided to make an attempt to save the eye, it is first irrigated, and a speculum is introduced, care being taken to produce as little pressure as possible on the globe. Then any prolapsed iris is cut off and freed from the edge of the wound with a repositor. Fine silk stitches may be inserted in the sclera if there is much gaping of the wound, but they must not penetrate the whole thickness of this coat. Silk sutures are used

for the conjunctiva. After a final irrigation a pad and bandage is applied. Atropine is instilled before tying the eye up, if the anterior chamber is formed.

There is a large group of doubtful cases which may be treated with cold compresses, atropine, and rest, and after a few days a more definite opinion may be formed as to whether or not the eye can be saved.

#### *Excision of the eye.*

*Instruments required.* Eye speculum, two pairs of sharp-toothed fixation forceps, a small straight blunt-pointed pair of scissors, a strabismus hook, a large strong blunt-pointed pair of scissors curved on the flat, a curved needle threaded with silk, and a needle holder.

*Operation.* A general anæsthetic is given, the eye is irrigated, and a speculum introduced.

The conjunctiva is grasped with fixation forceps close to the cornea, and is then divided all round the cornea with the smaller pair of blunt-pointed scissors. The subconjunctival space is then opened up with scissors as far back as the insertion of the recti muscles. The tendons of these muscles are caught up in turn on the strabismus hook, and divided as near the globe as possible. One of the lips of the ruptured globe is then grasped by fixation forceps and the globe drawn well forwards, care being taken not to express the contents of the globe into the orbit. The large curved scissors are then passed, closed, far back into the orbital cavity, and the optic nerve felt for and divided. The scissors which were used for cutting round the cornea must not be used for this purpose, as the conjunctival sac cannot be rendered perfectly sterile. Care must be taken in this stage to pass the scissors well back into the orbit, in order to avoid cutting through the stretched sclerotic instead of the optic nerve. To remove the eyeball, only the tendons of the two oblique muscles now require division. The cavity is irrigated, and the divided edge of the conjunctiva brought together with a purse-string horsehair suture. The application of a firm pad and bandage is generally sufficient to control the hæmorrhage.

#### *E. INJURY TO THE EYE BY BURNS AND CORROSIVES*

Should a patient be seen a few minutes after an injury by an acid or an alkali, an attempt may be made to neutralize it.

In the case of an *acid*, a solution of sodium bicarbonate, 10 grains to the ounce, is used.

For injury by an *alkali*, vinegar may be used. Otherwise it is best to flush out the conjunctival sac with a warm boracic acid lotion or water.

*Lime* is apt to produce a considerable degree of destruction, but, fortunately, it is usually more or less slaked. A strong solution of cane sugar is used, if obtainable, to wash the eye out; water would help to complete the slaking. All particles must be carefully removed from the globe and the conjunctival sac.

Atropine ointment is used and the eyes lightly bandaged in the treatment of these conditions, and a cold-water compress will usually give relief. The after-treatment must be directed towards limiting adhesions as much as possible.

*Grains of gunpowder* in the cornea and conjunctiva require removal with a needle; they may often be snipped out of the conjunctiva with a pair of scissors. In bad cases a general anæsthetic is needed, and atropine and cold applications are to be applied afterwards. If any grains of gunpowder have been removed from the cornea, the eye must be bandaged.

## II. DISEASES OF THE EYE THAT URGENTLY REQUIRE TREATMENT

(a) *Abscesses of lid*. These should be opened by an incision parallel to the orbital margin.

(b) *Ophthalmia neonatorum*. The lids should be everted daily and painted with a solution of silver nitrate, 10 grains to the ounce, special attention being paid to the retrotarsal fold. The eyes should not be tied up, and every attempt should be made to prevent secretions being retained in the conjunctival sac, and, above all, to avoid injuring the cornea in any way. The prognosis depends upon the integrity of the cornea. A perchloride of mercury lotion, 1 in 10,000, and warm sterilized water, are used alternately every hour through the day, and at longer intervals during the night. Boracic ointment may be used to smear along the lid margins at night.

Both eyes are usually attacked at the same time, but even if they are not it is almost impossible to prevent infection of the second eye.

If there is much spasm of the lids it is advisable to divide the external canthus. In this operation of *canthoplasty*, one blade of a blunt-pointed pair of scissors is passed horizontally outwards within the conjunctival sac at the external canthus, while the other blade extends over the skin, and the external canthus is

divided with one cut. During the operation the lids are separated widely and the external canthus put on the stretch. By this means the orbicularis is cut through and the spasm relieved.

(c) *Gonorrhœal ophthalmia in the adult* is a much more serious disease than in the infant. It begins in the large majority of cases in one eye, and every effort must be made to prevent infection of the other.

To this end the lid of the sound eye is everted and painted with silver nitrate solution,  $\text{℥0}$  grains to the ounce, and a Buller's protective shield is then applied to the eye (Fig. 96). This may



FIG. 96. Buller's shield.

be conveniently made by covering a watch-glass with a piece of strapping which has a hole cut in it less than the size of the watch-glass. Especial attention must be paid to make the strapping adhere firmly in the region of the bridge of the nose; it will require periodic readjustment. The patient should be directed to sleep with the affected side downwards. A small opening is left at the temporal side of the shield in order to prevent condensation on the watch-glass.

Silver nitrate and the perchloride lotion should be used as in the case of the infant. In washing out the eye a small rubber syringe should be used and the attendant should wear protective glasses.

In this as in other forms of conjunctivitis, scrupulous care

must be taken to avoid spreading the discharge in any way, so that handkerchiefs, towels, and bed-linen must be disinfected before they are washed.

(d) A *corneal ulcer*, especially if it is in an unhealthy condition and attended with hypopyon, often needs cauterization, and the most convenient method is to do this with pure liquid carbolic acid.

The eye is anæsthetized with cocaine, the extent of the ulcer having been previously ascertained by using a drop of a 2 per cent solution of fluorescein. The ulcerated area is thus stained green; the excess of fluorescein may be washed away by a few drops of the 2 per cent cocaine solution. An eye speculum is introduced. The eye is steadied, and the region round the ulcer dried with a gauze sponge or a piece of clean blotting-paper. A small camel hair brush, or the end of a wooden match, is then dipped into the pure carbolic acid and the ulcer is cauterized, care being taken that the fluid does not run about; special attention must be paid to the edges of the ulcer. Atropine is then instilled and the eye bandaged. The atropine should be continued until the inflammation has subsided, and a warm boracic lotion should be used thrice daily. As the general condition is often bad, the diet should be generous. It is usually advisable to keep the patient in bed.

A *Saemisch's section* may be necessary if the hypopyon is large enough to fill one-third or more of the anterior chamber, or if the ulcer seems likely to perforate, as evidenced by protrusion of Descemet's membrane, or if the tension of the eye is definitely increased.

*Operation.* Two per cent cocaine is instilled and the eye is irrigated. A speculum is introduced, and the conjunctiva fixed below by fixation forceps. A Graefe knife is then introduced with the cutting edge forwards, and made to open the anterior chamber and divide the base of the ulcer. The puncture and counter-puncture should be in healthy corneal tissue beyond the margins of the ulcer. The hypopyon in this class of case is viscid, and some of this material may be further removed with the smooth forceps, but the lens which has come forward must not be injured. The eye should be bandaged and atropine and a boracic lotion used.

It will be necessary to open the lips of the wound with a fine probe daily until healing has begun.

(e) *Keratitis with lagophthalmos*. The cornea may become exposed and also ulcerated, either on account of exophthalmos

or from cicatricial contraction of the lids. In milder cases the eye should be bandaged at night. Should ulceration, which will be in the lower part of the cornea, threaten, the lids must be sutured together.

(f) In *panophthalmitis* immediate excision of the eye is usually contra-indicated. This is on account of the possibility of purulent meningitis occurring, infection travelling along the optic nerve sheaths and spaces to the base of the brain.

In these cases the cornea and anterior segment of the globe should be removed and the contents of the eye evacuated as in an ordinary abscess, all the uveal tissue removed, and the cavity irrigated. The sclerotic tunic can be removed at a later date.

(g) *Acute iritis*. This is evidenced by a contracted pupil which reacts sluggishly or not at all to light. The iris is discoloured and its pattern rendered less distinct. The anterior chamber is deep, and the aqueous is turbid. There is a purple zone of circumcorneal infection which may, in some cases, be less evident owing to the presence of a general conjunctival infection. The pain is somewhat variable, but when marked it is of a neuralgic character in and around the eye. These conditions are also accompanied by photophobia and lacrimation.

*Treatment*. It is important to get the pupil dilated as soon as possible. By this means not only is rest obtained for the inflamed iris, but the danger of permanent damage to the eye by the formation of adhesions to the lens is reduced to a minimum. A one per cent atropine ointment is used every four hours for the first few days, and two per cent of cocaine may be advantageously combined with the atropine. The eye should be bandaged, at any rate at first, as this protects it from changes of temperature, and strong light should be avoided. If there is much pain the affected eye should be bathed with a hot boracic lotion four times a day. A couple of leeches applied to the affected temple often give marked relief to the pain, and facilitate the action of the atropine.

When the pupil has dilated, the applications of atropine are to be reduced in frequency, usually to two or three times a day. Cocaine, if it has been used with the atropine, must not be long continued on account of the deleterious effect its prolonged action has on the corneal epithelium.

Any constitutional cause underlying the iritis, such as syphilis or rheumatism, should be treated at the same time. The more severe cases are best kept in bed.



Occlusion of the pupil and extensive posterior synechiæ may require operative interference when the inflammation has subsided. An internal iridectomy will sometimes cure persistently recurring attacks of iritis.

(h) *Acute glaucoma.* In this serious disease, if proper and prompt treatment is employed, a degree of sight may be recovered which will be but little below what it was before the attack.

If wrongly treated, or if treatment is delayed for even a few days, the sight may be irreparably lost. In acute glaucoma the eye is injected, the cornea hazy, and the anterior chamber is shallow. The pupil is dilated, often oval, and inactive, and the tension of the globe markedly increased. The pain in and around the eye is very severe; it is frequently accompanied by vomiting, and the patient's general condition is much impaired. In acute glaucoma no view of the fundus oculi can be obtained owing to the condition of the media. Vision is greatly impaired. It is most frequently mistaken for an attack of migraine or biliousness, conjunctivitis or iritis.

*Treatment.* Iridectomy is imperatively called for, and it should be performed in an upward direction, unless the iris is here markedly narrowed, when its broadest part may be selected. The shallowness of the anterior chamber, with the forward position of the lens, is one of the chief causes that render this a difficult operation.

Eserine is to be instilled into both eyes before the operation, to anticipate the possible occurrence of an attack of glaucoma in the other eye. If both eyes are affected they are to be operated on at the same time.

*Operation.* A general anæsthetic should be given, the eye irrigated, and a speculum inserted. The conjunctiva is then seized with fixation forceps and the eye drawn down. A domed flap from 2 to 3 mm. in height is cut by means of a Graefe knife (Fig. 97). The puncture and counter-puncture should be from 1 mm. to 2 mm. from the apparent corneal margin (Fig. 98), and the incision should maintain this distance from the cornea throughout its entire length; the knife should be kept parallel to the plane of the iris while passing in front of it. The section should be made very slowly and a conjunctival flap cut above. The fixation forceps are then handed to the assistant, who takes a firm hold of the conjunctiva, which is often very friable, and rotates the globe downwards, without exerting any pressure on the globe itself. At this stage

the assistant should raise the speculum slightly forward off the globe, and this avoidance of pressure should be maintained throughout. The surgeon introduces the iris forceps, closed, catches the iris and draws it well out of the wound, and, while

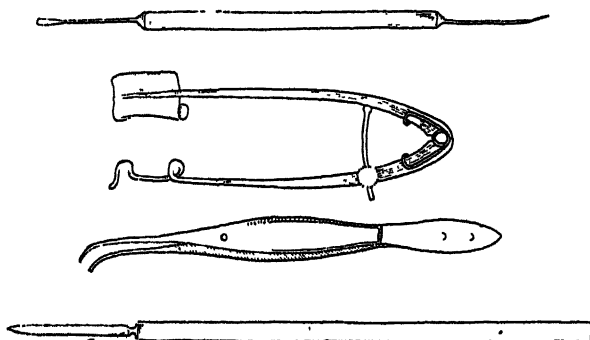


FIG. 97. Instruments for iridectomy.

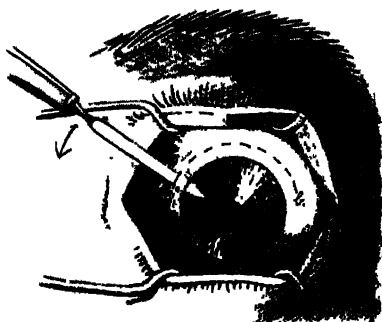


FIG. 98. Diagram showing puncture (*a*) and counter-puncture (*b*) in a glaucoma iridectomy. The dotted line represents the external orifice of the wound.

The point of the Graefe's knife is seen in the anterior chamber. It is inserted and kept throughout parallel to the plane of the iris; the point is directed towards the centre of the pupil at first, the handle is then carried downwards and the blade passed straight towards the counter-puncture (*b*). The fixation forceps are here omitted for the sake of clearness of the drawing. Those known as the French pattern take the firmest grip.

traction is maintained on one end, this end is divided with the iris scissors. Its base is then torn through and the other end drawn out and similarly divided. The repositor is now used to replace the iris and free its pillars from the edges of the wound. The eye is then bandaged.

The following points should be borne in mind :—

- (i) The wound should be in the sclera.
- (ii) The iris should be removed right down to its root.
- (iii) A wide iridectomy is desirable, and about a fifth of the circumference of the iris at the corneal margin should be removed.

The palliative methods which may be temporarily employed for acute glaucoma in an emergency are :—

(i) Eserine. A strong solution of the sulphate (one per cent) is used in drop form, and it may often be beneficially combined with five per cent cocaine. It does no good unless it contracts the pupil. If it contracts the pupil the root of the iris is drawn away from the angle of the anterior chamber, and for the time being the intra-ocular fluid has a more ready exit.

(ii) The general treatment is of importance. A brisk purge should be given, sleep induced, by morphia if necessary, and the patient kept warm in bed and not denied food.

(i) *Orbital cellulitis*. From whatsoever cause arising, this condition requires immediate treatment, chiefly on account of the risk of septic meningitis supervening. An incision is made through the lid, in the locality where pus is suspected, and free drainage provided.

If fluctuation is not obtained, an incision is made over the most tender spot, unless an indication can be obtained of the best situation for an incision from the direction of the proptosis; for instance, if the eye is displaced downwards and inwards, an incision is made into the upper and outer part of the orbit, parallel with the orbital margin.

(j) *Foreign bodies* within the orbit, and external to the globe, generally require removal, though small bodies, such as shot, are frequently well tolerated. In these cases the use of the X-rays has been of great value in deciding whether the foreign body is in, or outside, the globe.

(k) *Acute inflammation of the lacrimal sac*. The abscess which forms is to be opened by an incision over it, about half an inch in length, and extending downwards and a little outwards. The wound is kept open by a drain. At a later date, when the inflammation has subsided, it will probably be necessary to deal with the resulting lacrimal obstruction, either by syringing, dilatation, or excision of the sac.

(l) *Sympathetic ophthalmia*. This may attack an uninjured eye, owing to a wound of, or the retention of a foreign body in, the

other eye. • It is extremely rare for it to occur after an injury that causes suppuration in the first eye, unless a foreign body is also retained in it.

*Sympathetic irritation* is characterized by lacrimation ; weakness of accommodation ; slight redness, especially after exposure to light ; and occasionally pain in the uninjured eye. Arising in the uninjured eye it is a strong indication for the removal of the injured eye ; it is always cut short by this procedure.

*Sympathetic inflammation* is a very intractable form of plastic irido-cyclitis, which usually has a painless and insidious onset, and follows a similar affection in the injured eye. It is this condition which is so much to be dreaded, and of which sympathetic irritation is often the danger signal. Dots of keratitis punctata are seen in the lower quadrant of the cornea ; they must be carefully looked for with a magnifying glass aided by oblique illumination with a lens.

Sympathetic inflammation may occur, however, without a previous irritation, and irritation is not always followed by inflammation. There is always an interval before the uninjured eye becomes affected. An eye may be retained for three weeks after an injury without much risk, but after that time, if it is not quieting down, it should be excised, except under exceptional circumstances.

If sympathetic inflammation has already begun in the uninjured eye, the injured eye should not be excised unless it is visually worthless, as it may eventually turn out to be the more useful eye of the two. The possibility also of mitigating the attack by removing the exciting eye when once the disease is well established is uncertain.

- The commonest time for the origin of an attack in the 'sympathizer' is from four to eight weeks after the injury, when the inflammation in the 'exciter' is at its height.

The retention of a foreign body in an eye may at any time set up an attack of inflammation in that eye, so that in this case it is always a potential source of sympathetic inflammation in the other eye.

#### • *Indications for Excision of the Injured Eye*

1. If the injured eye is hopelessly disorganized it should be excised.
2. If the injured eye shows no signs of quieting down after three weeks it should be excised, unless the other eye has very

defective vision whilst the injured eye is still capable of moderate vision.

3. If a foreign body is present in the eye, and cannot be removed, the eye should be excised, provided that the other possesses fair vision. If the foreign body is setting up irritation the indication for excision is still more urgent.

4. If sympathetic inflammation is beginning in the other eye, and the exciter is visually worthless, it should be excised.

5. A blind inflamed eye which has been subject to attacks of recurrent inflammation is to be excised.

6. Sympathetic irritation in the other eye is a strong indication for excision of the injured eye.

It should be borne in mind that wounds involving the circum-corneal zone, especially when there is incarceration of the iris or ciliary body, are those which are most likely to set up sympathetic inflammation.

The exciting eye should not be excised if the attack of inflammation in the other eye is established, unless the exciter is blind.

## CHAPTER XXIII

### POISONING

#### GENERAL PRINCIPLES

1. *Evacuate the stomach contents* by lavage or emesis, except in the case of corrosive substances such as mineral acids and strong caustics. For lavage use a soft rubber tube.
2. *Administer the appropriate antidote.*
  - (a) Chemical antidote.
  - (b) Physiological antidote, if one be known.
3. *Hasten elimination of the poison.*

In poisoning by alkaloids, intravenous infusion of normal saline solution is useful. Venesection may also be done with advantage, removing from 15 to 20 ounces of blood.
4. *Treat other symptoms.*

*Pain.* If severe, give morphia hypodermically.  
*Collapse.* Hot bottles and hot blankets. Give strong coffee by mouth or rectum. Elevate the foot of the bed.  
*Syncope.* Ammonia and ether by mouth, subcutaneous injections of ether and strychnine. Faradism. Intravenous saline infusion.  
*Respiratory failure.* Artificial respiration; cold affusions; tracheotomy if there is laryngeal obstruction; oxygen inhalations.
5. Give demulcents after the urgent and immediate symptoms have been attended to.
6. Preserve the contents of the stomach, as subsequent examination may be necessary.

#### EMETICS

1. Mustard—one tablespoonful in a tumblerful of warm water.
2. Zinc sulphate—30 grains in a tumblerful of warm water.
3. Copper sulphate—10 grains in a tumblerful of warm water.
4. Apomorphine— $\frac{1}{16}$  grain hypodermically.
5. Powdered ipecacuanha—30 grains in water.

#### NOTE

Some of the more important poisons are dealt with in the following alphabetical list, especially those for which a definite

antidote is available. For poisons not mentioned the treatment should be on the general lines above described.

ACID, CARBOLIC. Creosote. Disinfecting fluid.	<i>Lavage</i> with care. Wash stomach out with solution of magnesium or sodium sulphate, $\frac{1}{2}$ oz. in 8 oz. of water. <i>Demulcents.</i> Milk and olive oil. <i>Stimulants.</i> Freely. Intravenous or rectal injections of normal saline.
ACID, CHROMIC.	<i>Lavage.</i> Stomach tube to be used with great care. <i>Chemical Antidote.</i> Chalk, $\frac{1}{2}$ oz. in $\frac{1}{2}$ pint of milk. <i>Demulcents.</i> Milk, olive oil, gruel, or white of egg.
ACID, HYDROCYANIC. Cyanides. Bitter almond oil.	<i>General Principles.</i> Particularly treatment for respiratory failure. <i>Stimulants.</i> Ammonia and ether and brandy by mouth. Inhalations of ammonia.
ACID, OXALIC. Salt of sorrel. Salt of lemon.	<i>CAUTION.</i> <i>Lavage or emetics</i> only if case is treated soon after the poison is swallowed. <i>Chemical Antidotes.</i> Chalk, whiting, or wall-plaster, $\frac{1}{2}$ oz. stirred up in water; sacch. solution of lime, 2 drachms in water; repeated every $\frac{1}{2}$ hour for eight doses. <i>CAUTION.</i> Do not give sodium or potassium carbonates; the resulting compounds are soluble and poisonous. <i>Demulcents.</i> Milk, olive oil, gruel, or white of egg.
ACIDS, MINERAL. Hydrochloric. Nitric. Sulphuric. Spirit of salt. Muriatic. Aqua fortis. Acetic. Butter of antimony. Soldering fluid. Battery fluids.	<i>CAUTION.</i> <i>Lavage or emetics</i> inadmissible. <i>Chemical Antidotes.</i> Magnesia, $\frac{1}{2}$ oz. stirred up in water; chalk, whiting, or wall-plaster, $\frac{1}{2}$ oz. stirred up in water; sodium or potassium bicarbonate, 2 drachms in water; sacch. solution of lime, 2 drachms in water. <i>Demulcents.</i> Milk, white of egg, thick gruel.
ACONITE. Monkshood. Aconitine.	<i>General Principles,</i> especially treatment for respiratory failure. <i>Stimulants.</i> Strychnine hypodermically. Brandy. <i>Saline Infusion.</i>
ALCOHOL.	<i>General Principles,</i> especially cold affusions, faradism, artificial respiration. Hot coffee <i>per rectum.</i>
ALKALIES. Potash. Soda. Ammonia. Hartshorn. Wood-killer.	<i>CAUTION.</i> If much destruction of mucous membrane, do not use stomach tube; otherwise use it with care. Emetics inadmissible. <i>Chemical Antidotes.</i> Citric or tartaric acids, 20 grains in water; vinegar or lemon-juice, 1 oz. in water. <i>Demulcents.</i> Olive oil, milk, white of egg. <i>Stimulants.</i> (Not ammonia.)

ANILINE.	<p><i>General Principles</i>, especially treatment for respiratory failure.</p> <p><i>Venesection</i>. One pint followed by infusion with normal saline.</p>
ANTIMONY SALTS. Tartar emetic. Butter of antimony.	<p><i>General Principles</i>, especially stimulants and treatment for collapse.</p> <p>CAUTION. Avoid lavage after butter of antimony (see acids).</p> <p><i>Chemical Antidote</i>. Tannic acid, gr. xx in water or strong tea.</p> <p><i>Demulcents</i>. Milk, white of egg.</p>
ARSENIC COMPOUNDS. White arsenic. Weed-killers. Some vermin-killers. Sheep dips. Some fly-papers. Emerald green.	<p><i>General Principles</i>, unless in poisoning by strongly alkaline weed-killers, when lavage must be applied cautiously or not at all.</p> <p><i>Chemical Antidote</i>. Hydrated ferric oxide, made when required by adding to <math>\frac{1}{2}</math> oz. of liquor ferri perchlor. in a tumblerful of water <math>\frac{1}{2}</math> oz. of magnesia or <math>\frac{1}{2}</math> oz. washing soda in water. Collect the precipitate on a handkerchief, mix with half tumblerful of hot water, and repeat frequently.</p> <p><i>Demulcents</i>.</p>
ATROPINE. Nightshade. Belladonna. Stramonium. Hyoscyamus. Hyoscyne.	<p><i>General Principles</i>, especially treatment for respiratory failure.</p> <p><i>Chemical Antidote</i>. Tannic acid, gr. xx in water or strong tea.</p> <p><i>Physiological Antidote</i>. Pilocarpin nitrate, <math>\frac{1}{4}</math> grain hypodermically.</p>
BARIUM SALTS.	<p><i>General Principles</i>.</p> <p><i>Chemical Antidote</i>. Magnesium or sodium sulphate, <math>\frac{1}{2}</math> oz. in 8 oz. of water.</p>
CALABAR BEAN Physostigmine. Eserin.	<p><i>General Principles</i>.</p> <p><i>Chemical Antidote</i>. Tannic acid, gr. xx in water.</p> <p><i>Physiological Antidote</i>. Atropine sulphate, gr. <math>\frac{1}{10}</math> hypodermically and repeated every 15 minutes until pupils dilate.</p>
CAMPHOR. Camphorated oil (Lin. Camph.).	<p><i>General Principles</i>.</p>
CANTHARIDES.	<p><i>General Principles</i>.</p> <p><i>Demulcents</i>.</p>
CHLOROFORM.	<p><i>Inhaled</i>. See Anaesthetics</p> <p><i>Swallowed</i>. <i>General Principles</i>.</p>
COCAINE.	<p><i>General Principles</i>.</p> <p><i>Inhalations</i> of amyl nitrite.</p>
CONIUM. Hemlock.	<p><i>General Principles</i>.</p>
COPPER. Blue vitriol. Verdigris.	<p><i>General Principles</i>.</p> <p><i>Chemical Antidote</i>. Potassium ferrocyanide, gr. xx in water.</p> <p><i>Demulcents</i>. Milk.</p>



<b>DIGITALIS.</b> Foxglove.	<i>General Principles.</i> <i>Chemical Antidote.</i> Tannic acid, gr. xx in water or strong tea.
<b>FUNGI.</b>	<i>General Principles.</i> Atropine sulphate, gr. xh hypodermically.
<b>GASES.</b> Carbon monoxide. Carbon dioxide. Coal gas. Sewer gas. Acetylene. Chlorine. Nitrous fumes.	<i>General Principles,</i> especially artificial respiration and oxygen inhalations.
<b>HYPNOTICS.</b> Chloral hydrate. Chloralamide. Sulphonal. Paraldehyde.	<i>General Principles.</i> <i>Stimulants.</i> Especially strychnine hypodermically.
<b>IODINE.</b>	<i>General Principles.</i> <i>Chemical Antidote.</i> Sacch. sol. of lime, 2 drachms in water. <i>Demulcents,</i> copiously.
<b>IRRITANTS, VEGETABLE.</b> Unidentified plants. Violent purgatives. Nicotine. Tobacco. Savin. Squill.	<i>General Principles.</i> <i>Demulcents.</i>
<b>LEAD SALTS.</b>	<i>General Principles</i> <i>Chemical Antidote.</i> Magnesium or sodium sulphate, $\frac{1}{2}$ oz. in tumblerful of water.
<b>MERCURY SALTS.</b> White precipitate. Red precipitate. Corrosive sublimate.	<i>General Principles.</i> <i>Demulcents.</i> Milk and white of egg.
<b>MINERAL OILS.</b> Benzoline. Paraffin. Petroleum.	<i>General Principles.</i> <i>Demulcents.</i> Olive oil freely, followed by free lavage with milk.
<b>MORPHINE.</b> Opium. Codeine. Syrup of poppy. Soothing syrup. Chlorodyne. Laudanum. Paregoric. Heroin. Battley's solution. Dalby's carminative.	<i>General Principles.</i> <i>Chemical Antidotes.</i> Tannic acid, gr. xx in water, freely washing out after each dose; or wash out stomach with solution of potassium permanganate, gr. j to 2 oz. of water. <i>Physiological Antidote.</i> Atropine sulphate, gr. xh. <i>Stimulants</i> freely, but do not overdo rousing and forced movements.

PHOSPHORUS. Rat paste.	<p><i>General Principles.</i>  <i>Chemical Antidotes.</i> Copper sulphate, gr. 2½ in 3 oz. water; French turpentine or sanitas, 30 m. in 1 oz. water, repeated about four times in the first hour.  <i>Demulcents.</i> CAUTION. Avoid oil.</p>
PILOCARPINE.	<p><i>General Principles.</i>  <i>Chemical Antidote.</i> Tannic acid, gr. xx in water.  <i>Physiological Antidote.</i> Atropine, gr. ʒ<sub>ss</sub> subcutaneously.</p>
PROMAINE. Stale food. Canned food.	<p><i>General Principles,</i> especially treatment for collapse.  <i>Chemical Antidotes.</i> Tannic acid, gr. xx in water; calomel, gr. v, followed by saline purge.</p>
SILVER SALTS.	<p><i>General Principles.</i>  <i>Chemical Antidote.</i> Table-quantity of common salt in water.</p>
STRYCHNINE. Battie's vermin-killer.	<p><i>General Principles.</i>  <i>Chloroform</i> by inhalation.  <i>Emesis</i> by apomorphine, or <i>lavage</i> as soon as patient is under influence of chloroform.  <i>Chemical Antidote.</i> Tannic acid, gr. xx in water.  <i>Physiological Antidote.</i> Chloral hydrate, gr. 40 in water, or potassium bromide, gr. 60, repeated if necessary.</p>
TURPENTINE. Polishing fluid.	<p><i>General Principles.</i> Lavage with milk.</p>
ZINC SALTS. White Vitriol. Burnett's fluid. Soldering fluid.	<p>CAUTION. Lavage and emetics inadmissible except in poisoning by neutral zinc salts.  <i>Chemical Antidote.</i> Sodium or potassium bicarbonate, 2 drachms.  <i>Demulcents.</i> Milk and white of egg.</p>



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